
THE UNIVERSITY
*of* ADELAIDE

# MOVING AVERAGE TECHNICAL ANALYSIS: FACT, FICTION OR SOMEWHERE IN BETWEEN?

Daniel M. Orlovsky

Supervisors: Dr. Paskalis Glabadanidis & Dr. Jiun-Lin (Alex) Chen

May 17, 2021

The University of Adelaide
Faculty of Professions
Business School, Finance & Banking
Adelaide, South Australia

# Dedication

There were many times throughout my tenure as a PhD student when I did not think I would see the light at the end of the tunnel. Throughout my candidature I faced many obstacles, many of which required significant periods of leave. Each time I returned to my studies it became more difficult to believe in myself and my ability to reach the end result.

My most trying period came in 2019 when I was diagnosed with Hodgkin's Lymphoma. It was the most difficult 6 months of my life. If not for the support of my partner, my family, my friends and my supervisor, I do not believe I would have made it through such a trying time. Their encouragement and support during and after were vital to my long term mental and physical health. As a result, I felt empowered to continue my studies and finish what I started.

I am blessed to have such amazing people in my life who love, support and encourage me to be all that I can be. I would not be the person I am today without each and every one of them. As such, I dedicate this PhD to them. It would not exist without them. I do not think I would either.

Thank you.

# Table of Contents

# List of Tables

# List of Figures

# List of Appendices

# Abstract

The Moving Average (MA), is it fact, fiction or somewhere in between? Previous research has begun to show its value in decision making. The following dissertation provides further evidence in support, with results showing its performance is negatively correlated to asset size, inconsistent for book-to-market, with declining performance in recent decades. MA performance cannot be maintained for assets with extreme volatility such as cryptocurrencies. Delay of any decision making following a buy/sell signal negatively alters the result. The risk reducing benefits to the MA are universal. Overall, it provides little downside risk but provides huge upside potential.

# Plagiarism Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

In addition, I certify that no part of this work will, in the future, be used in a submission in my name for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

I give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time. I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

Daniel M. Orlovsky
May 17, 2021

# 1.0 Introduction

## 1.1 Predicting Future Market Prices

Finance is the management of money by governments, corporations and individuals; as the saying goes, 'money makes the world go round.' For as long as money has existed, the drive to increase wealth has continued unabated. One such method of wealth creation is attempting to predict future market prices and buying or selling accordingly.

For example, imagine there are two investors. Investor A and B are both interested in predicting the future market price to determine whether to buy, sell or hold. Investor A's analysis leads to the belief the value will increase. Investor B's analysis leads to the belief the value will decrease. In the course of their decision making, both investors have access to the same information. However, Investor A utilises a more robust analysis of the available information and is therefore more likely able to profit because while the information available to both investors is the same, the ability to process the information and come to a more robust conclusion was asymmetrical. The market in this case was inefficient. Consider the example, but now assume Investor B's analysis was as robust as Investor A. In this case, Investor A and B would likely come to the same future market price prediction and thus Investor B would never sell the asset for anything less than the expected future price. The information known and processing used by both investors is now symmetrical. The market is efficient.

As the example highlights, the key to profiting from future market price fluctuations is asymmetrical processing of information. If an investor can devise some method of successful prediction other investors do not have access to, whether it be through accessibility or simply desire, the investor should be able to make an abnormal return increasing wealth. In finance,

there are three distinct methods for predicting future prices: technical analysis, fundamental analysis and insider trading.

Technical analysis is the study of historical asset prices and volume. The purpose is to identify historical trends which can be used to predict future asset prices. Fundamental analysis is the study of an asset's publicly available information to predict its value and corresponding price. Public information is any information that is freely accessible by all investors. Insider trading is the use of private information to predict future prices. Private information is any information that is not accessible by the public. This method of wealth creation is illegal. This prevents investors from trading using insider knowledge and generating an abnormal return through the guaranteed use of asymmetrical information. When using technical and/or fundamental analysis, the abnormal return is far from guaranteed.

In academia, fundamental analysis has been highly scrutinised and accepted in literature (Lo, Mamaysky & Wang 2000). Conversely, technical analysis is at best viewed by academics with scepticism and until recently the attitude towards it can be summarised in a quote by Malkiel (1981, pp. 127-128):

> "Obviously, I am biased against the chartist. This is not only a personal predilection, but a professional one as well. Technical analysis is anathema to the academic world. We love to pick on it. Our bullying tactics are prompted by two considerations: (1) the method is patently false; and (2) it's easy to pick on. And while it may seem a bit unfair to pick on such a sorry target, just remember: it is your money we are trying to save."

This extreme viewpoint has begun to wane in recent years, in no small part due the level of usage by fund managers and investors. An in depth analysis on the usage of technical

analysis in asset allocation decisions by fund managers was performed by Menkhoff (2010). A survey was performed on 692 fund managers to ascertain the importance placed on technical and fundamental analysis. Menkhoff (2010) found 87% use technical analysis, with 77% of those giving an importance rating of 10% or more and 20% of fund managers preferring technical to fundamental analysis. The findings of Menkhoff (2010) highlight a fundamental difference of opinion between practitioners and some circles of academia with regards to technical analysis. This has been the case for decades, with Alexander (1961, p. 7) stating:

> "There is a remarkable contradiction between the concepts of behavior of speculative prices held by professional stock market analysts on the one hand and by academic statisticians and economists on the other."

If Malkiel (1981) is correct in labelling technical analysis "patently false," why are finance practitioners of the belief technical analysis is a viable trading strategy and valuable source of information? Conceivably the answer is simply practitioners believe it is better to use it, gaining at worst nothing, than not, missing out on valuable information. Practitioners are then, as the saying goes, 'hedging one's bets.' However, it is also conceivable practitioners truly believe, through experience, knowledge or both, technical analysis is a profitable trading strategy. Irrespective of the answer, the usage of technical analysis in practice emphasises the importance of research in this area.

## 1.2 The Importance of Technical Analysis in Research

For centuries, there has been attempts to predict market fluctuations in prices, from eighteenth century Japanese developing a form of technical analysis known as candlestick charting (Nison 1991) to trading equity on a Stock Exchange. Only in the last few decades have academics attempted to thoroughly examine whether predicting price fluctuations is a reality, or simply a case of fortuitous luck.

The attempt to predict future price fluctuations from historical prices, contradicting the belief markets follows a random walk, is known as technical analysis, best defined by Pring (2002, p. 3), a leading technical analyst:

> "The technical approach to investment is essentially a reflection of the idea that prices move in trends that are determined by the changing attitudes of investors toward a variety of economic, monetary, political, and psychological forces. The art of technical analysis, for it is an art, is to identify a trend reversal at a relatively early stage and ride on that trend until the weight of the evidence shows or proves that the trend has reversed."

One of the first recognised technical analysis works is a text by Edwards and Magee titled Technical Analysis of Stock Trends, originally published in 1948, now in its tenth edition (Edwards, Magee & Bassetti 2012). This text covers a wide variety of technical indicators and how they are implemented and supplemented by theory. The text was published when technical analysis was in its infancy in academic research. Academia has continued to investigate technical analysis throughout the decades, but it was not until the late 1980's that researchers began to incorporate statistical tests and adjust for transaction costs and risk (Park & Irwin 2007).

As mentioned in Section 1.1, the two permitted and distinct methods for predicting future prices are fundamental analysis and technical analysis. To achieve abnormal returns, both methods must exploit market price inefficiencies. Therefore, any asset traded must be inefficiently priced based on its fundamentals and the information available to investors.

To understand how information is processed in capital markets, Fama (1970) developed the Efficient Markets Hypothesis (EMH). The EMH assumes as information becomes available for an asset, the price immediately adjusts to incorporate this new information. The implication for investors is attempting to predict future price fluctuations will not result in a return greater than a simple buy-and-hold strategy (Jensen & Benington 1970). This is consistent with the belief market prices are martingales and follow random walks (Fama 1995).

It is important to note, the EMH assumes "the market is said to be efficient with respect to some information set if security prices would be unaffected by revealing that information to all participants" (Malkiel 1989, p. 1313). This implies market efficiency requires a significant level of information symmetry. In practice however, it is hard to justify such an assumption. For instance, a term widely used in literature, and coined by Black (1986) to explain market inefficiencies is 'noise traders.' These investors use 'noise,' which is imagined or irrelevant information, to trade in the mistaken belief it will achieve higher returns. Consequently, 'noise' traders add non-fundamental risk to the underlying asset, leading to market prices significantly diverging from fundamentals (Long et al. 1990). This divergence is a direct result of asymmetric information and processing. If this is the case, it raises questions about the legitimacy of arguing against technical analysis as a means of extracting useful information for trading.

Furthering this argument, the quote above by Malkiel (1989) states "all participants." Is it reasonable to assume all investors, large and small, have access to the same knowledge, skill and understanding regarding financial markets? While it is true all investors have access to public information including past prices and volume, access to an information set is not the same as understanding an information set, as clearly evidenced by the existence of 'noise traders.' It is this distinction which leads to the following supposition regarding technical analysis.

Whether the market is efficient, as access is only required, or the market is inefficient, as access and understanding is required, technical analysis is a legitimate source of useful trading information. This is because, in either case, 'noise traders' and other market anomalies cause significant price changes contradicting fundamentals. Therefore, if it is assumed investors who use technical analysis are informed traders, any significant price changes, if predicted at least 51% of the time, will result in abnormal returns to the investor.

Conversely, if it is assumed Malkiel (1981) and other dissenters are correct, and technical analysis is "patently false," then this implies up to 87% of fund managers, based on Menkhoff (2010), are trading on imagined or irrelevant information. Therefore, any fund manager utilising technical analysis is according to Black (1986), a 'noise trader.' These 'uninformed informed trader's' believe using technical indicators is a profitable trading strategy, thus creating false information, leading to trading through asymmetric information. Since the market believes these traders are 'informed', when in fact they are currently the uninformed majority, it creates a 'self-fulfilling prophecy.'

For example, assume Stock A is currently being traded by technical traders X, Y and Z. At a point in time, a technical indicator or a combination of indicators used triggers a buy signal. Traders X, Y and Z immediately attempt to purchase Stock A, resulting in increased demand,

increasing the price of Stock A. At this point, it is irrelevant whether the technical indicator contained useful information, as the technical traders using this information have created a 'self-fulfilling prophecy.' Thus, even if predicting price fluctuations using technical analysis is not a reality, utilising it can still enhance profitability and with vast improvements in available technology, technical trading has never been easier, nor quicker.

Corroborating the aforementioned supposition can be found in the findings of Neely et al. (2014), which analysed the profitability of technical and fundamental analysis, finding very little comparative difference. In addition, when used simultaneously, the strategies profitability is even greater than each in isolation. The findings of Neely et al. (2014), which complement the findings of Menkhoff (2010), highlight a critical fact about technical analysis academia appear to disregard when they point out the flaws of the strategy; Practitioners use technical analysis. While the survey of Menkhoff (2010) is only a sample, consider the implications if the findings hold across the entire global market.

## 1.3 The Types of Technical Indicators

In Section 1.2, it was established why technical analysis is important in research. This section will detail the common types of technical indicators utilised in practice and investigated in academia.

There are six main indicators analysed in research over the last few decades: filter rules, stop-loss orders, channel rules, momentum oscillators, relative strength and moving averages (Park & Irwin 2007).

Early literature, prior to 1988, focused primarily on filter rules (Park & Irwin 2007). The filter rule generates a signal to the investor when a closing price increases (decreases) by a set percentage above (below) a previous low (high) price, normally the most recent. This strategy attempts to filter out irrelevant price movements, focusing only on 'trends' that appear to be continuing into the future. Results were inconsistent with regards to the filter rule, with Alexander (1961), Fama and Blume (1966) finding very little supportive evidence. Sweeney (1986, 1988) was partially supportive but stated the results could be compensation for risk. Sweeney stated the belief that with so many variables with regards to trading, the only way to truly know if the filter rule worked was to actually trade in real time with real money. More recent literature has found in favour of the filter rule, with Corrado and Lee (1992) and Taylor (1992) both finding evidence supportive of filter rule.

The stop-loss order is one of the simpler technical indicators, generating a sell signal to investors whenever the current price decreases by a set percentage below the initial price. This strategy does not attempt to time the market for added gains, but instead seeks to increase profits through mitigating losses. Very little research has been done on this strategy, likely due to its focus on loss prevention. Houthakker (1961) did find in favour of the strategy

to reduce losses.

The channel rule seeks to determine if an assets price breaches a specified channel length. A buy (sell) signal is generated when the closing price is higher (lower) than the highest (lowest) price in the specified channel. This strategy assumes asset prices trend between set values. If a breach occurs above (below) the channel, it signals the price is going to continue trending in an upward (downward) direction. Donchian (1960) discuss the possible benefits of the channel rule and Irwin and Uhrig (1984) found in favour of the channel rule in certain time periods, although hesitant to outrightly discard the random walk hypothesis.

The momentum oscillator indicator attempts to determine if the daily asset closing price is increasing (decreasing) on average over a set period more than a set expected threshold, with a buy (sell) triggered if the threshold is broken. The strategy attempts to profit from market price momentum, ideally investing (divesting) early enough to maximise investors' return. Smidt (1965) found some evidence to support this strategy.

The relative strength indicator attempts to determine the magnitude of recent increases (decreases) in the asset price in order to isolate occurrences of over demand (supply). The most common method of determination is if the indicator's value is greater (less) than 70 (30) then a buy (sell) signal is generated (Wilder 1978). Levy (1967) found in favour of the strategy, refuting the random walk hypothesis. However, Jensen and Benington (1970) found the opposite, supporting the random walk hypothesis.

The moving average indicator assumes asset prices fluctuate around a medium to long-run average. The indicator attempts to identify when the stock price is trending, with a short-run moving average rising above (below) a long-run moving average generating a buy (sell) signal to the investor. Early studies suggested the moving average was not a viable trading strategy with Van Horne and George (1967, 1968), James (1968) and Dale and Rosemarie

(1980) all finding the strategy had very little benefits. Cootner (1962) however did find the moving average to be a profitable strategy for investors.

In recent years the moving average strategy has seen a resurgence in research, likely due to it being the most widely used indicator by investors when utilising technical analysis (Brock, Lakonishok & LeBaron 1992). A more detailed analysis of the moving average indicator is contained in Section 1.4 and 1.5.

## 1.4 The Moving Average

The moving average technical indicator is simple to calculate and use, in all likelihood the reason for its popularity by traders. As previously stated, the moving average has seen a resurgence in research initiated in part by the findings of Brock, Lakonishok and LeBaron (1992). Their findings suggest the moving average provides investors with strong predictive power, achieving high abnormal returns. However, their results did not consider transaction costs present in trading which led some to disregard their findings.

The findings of both Zhu and Zhou (2007, 2009) and Faber (2009) support the use of the moving average technical indicator to achieve abnormal returns above a simple buy and hold strategy. One notable finding from Faber (2009) was that the moving average appeared to allow an investor to achieve equity style returns whilst taking fixed income security style risk.

Han, Yang and Zhou (2013) continued research on the moving average, finding a positive relationship between profitability and portfolio volatility. Their findings led them to theorise the profitability-volatility relationship is caused by investor over and underreaction; as volatility increases, uncertainty rises and so too does the over and underreaction leading to the moving average capturing this as abnormal returns.

Continuing on from Han, Yang and Zhou (2013), Glabadanidis (2014, 2015, 2017) continued researching the moving average, determining statistically significant positive abnormal returns when sorting portfolios on various fundamentals, when investing in Real Estate Investment Trusts (REITs) and when using a combination of moving averages in tandem.

A clear conclusion begins to be drawn when looking at the latest literature; the moving average technical indicator has predictive power and achieves abnormal returns when

compared to a simple buy and hold strategy. The subsequent research presented in Section 2, 3, 4 and 5 will concentrate on the moving average.

## 1.5 The Moving Average Methodology

The moving average strategy used in Section 2, 3, 4 and 5 follows and expands upon the methodology used by Glabadanidis (2017). Let $MA_{it,n}$ represent the moving average (MA) for portfolio *i* at time *t* with a length of *L* periods, calculated using the average price level $P_{it}$ of portfolio *i* as follows:

$$MA_{it,L} = \frac{P_{it-L+1} + P_{it-L+2} + \cdots + P_{it-1} + P_{it}}{L}$$

The strategy requires the investor to monitor the stocks MA, identifying a buy in or sell out indicator. A buy signal occurs when the MA decreases below the relative stock price and a sell signal occurs when the MA increases above the relative stock price.

Using this method, the returns for the strategy are given by:

$$\tilde{R}_{it+n,L} = \begin{cases} R_{it+n} & , \; if \; P_{it-1} > MA_{it-1,L} \; and \; P_{it-2} > MA_{it-2,L}, \\ R_{it+n} - \tau & , \; if \; P_{it-1} > MA_{it-1,L} \; and \; P_{it-2} < MA_{it-2,L}, \\ r_{ft} & , \; if \; P_{it-1} < MA_{it-1,L} \; and \; P_{it-2} < MA_{it-2,L}, \\ r_{ft} - \tau & , \; if \; P_{it-1} < MA_{it-1,L} \; and \; P_{it-2} > MA_{it-2,L}, \end{cases}$$

where *n* represents the time taken between the indicators signal and implementation of the strategy, $\tau$ represents the transaction cost imposed when buying or selling the single stock and $r_{ft}$ is the risk-free rate. The transaction cost only occurs when buying and selling the portfolio and not the risk-free asset. This follows from Balduzzi and Lynch (1999, 2000), Han (2006) and Glabadanidis (2017). While Balduzzi and Lynch (1999) state an appropriate transaction cost is between 1 and 50 basis points, this paper will set the transaction cost $\tau$ equal to zero. However, the paper will report the break-even transaction cost for each strategy as utilised in Glabadanidis (2017). This ensures the reader can apply their own transaction cost expectations to the strategy and compare it to the break-even amount.

This method however is expanded upon to include additional features to further test the effectiveness of the MA. Firstly, a trading signal is only generated when the $P_{it}$ and $MA_{it,L}$ differ by a fixed percentage *f*. Secondly, a trading signal is only generated when the $P_{it}$ and $MA_{it,L}$ differ for a fixed number of days *d*. Lastly, all changes in position are held for a minimum number of days *h*. Each of these variables [*f*, *d*, *h*] are set ex-ante with returns calculated ex-post.

This paper will also utilise the methodology for the combination moving average (CMA) created by Glabadanidis (2017). This methodology assumes 6 MA strategies are used, with an average taken of the performance, such that:

$$\widetilde{CMA}_{it+n} = \frac{\tilde{R}_{it+n,5} + \tilde{R}_{it+n,10} + \tilde{R}_{it+n,20} + \tilde{R}_{it+n,50} + \tilde{R}_{it+n,100} + \tilde{R}_{it+n,200}}{6}$$

Once the returns of the CMA strategy are found, an excess return can be constructed assuming a long position in the CMA and a short position in the underlying portfolio using a buy and hold (BH) strategy. This excess return is given by:

$$TIS_{it} = \widetilde{CMA}_{it+n} - R_{it+n}$$

where $TIS_{it}$ is the Technical Indicator Spread (TIS), $\widetilde{CMA}_{it+n}$ is the return accrued through the use of the technical indicator and $R_{it+n}$ is the return of the buy and hold strategy, both given at time $t+n$, where *n* is the time taken between signal and implementation. The TIS will then be regressed using existing regression models to test for statistical significance. A statistically significant result implies the MA is superior compared to a passive BH strategy and generates an abnormal return.

## 1.6 Factor Regression Models

To test whether the MA is superior to the BH, regression analysis is performed on the TIS to determine statistical significance.

Following from Han, Yang and Zhou (2013) and Glabadanidis (2015, 2017), to determine whether the profitability of the strategy is statistically significant, the TIS will be regressed against the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model and the Carhart 4-Factor Model.

The CAPM was derived by Sharpe (1964) and Lintner (1965) using the mean-variance framework developed by Markowitz (1952). This single factor model characterises a linear relationship between expected return and systematic risk. Additionally, Fama and French (1992, 1993) found that firm size and book-to-market equity contribute to expected returns. As a result, the Fama-French 3-Factor Model was created, using small minus large and value minus growth as proxies for the small and value anomalies. Furthermore, following from the momentum findings of Jegadeesh and Titman (1993) and Chan, Jegadeesh and Lakonishok (1996), Carhart (1997) formed a 4-factor model, using the Fama-French 3-Factor Model with momentum as the fourth factor.

Thus, the first three asset pricing models used in the regression analysis are as follows:

$$TIS_{it} = \alpha_i + \beta_{i,m} r_{mkt,t} + \varepsilon_{it}, \tag{1}$$

$$TIS_{it} = \alpha_i + \beta_{i,m} r_{mkt,t} + \beta_{i,smb} r_{smb,t} + \beta_{i,hml} r_{hml,t} + \varepsilon_{it}, \tag{2}$$

$$TIS_{it} = \alpha_i + \beta_{i,m} r_{mkt,t} + \beta_{i,smb} r_{smb,t} + \beta_{i,hml} r_{hml,t} + \beta_{i,umd} r_{umd,t} + \varepsilon_{it}, \tag{3}$$

where $r_{mkt,t}$ is the excess market return, $r_{smb,t}$ is the excess return of the small firm anomaly, $r_{hml,t}$ is the excess return of the value firm anomaly and $r_{umd,t}$ is the excess return on momentum.

Using the moving average indicator to trade represents a market timing strategy. Therefore, two factors will be used to test against market timing ability.

The first method follows from Treynor and Mazuy (1966) who found a proxy for market timing by squaring the market return. The regression model is as follows:

$$TIS_{it} = \alpha_i + \beta_{i,m} r_{mkt,t} + \beta_{i,m^2} r^2{}_{mkt,t} + \varepsilon_{it}, \quad (4)$$

where a positive $\beta_{i,m^2}$ represents evidence in favour of market timing ability.

The second method uses the Henriksson and Merton (1981) state variant beta approach based on a positive movement of the market return given by:

$$TIS_{it} = \alpha_i + \beta_{i,m} r_{mkt,t} + \gamma_{i,m} r_{mkt,t} I_{(r_{mkt,t} > 0)} + \varepsilon_{it}, \quad (5)$$

where $I_{(r_{mkt,t} > 0)}$ is a dummy variable taking the value 1 if the market return is greater than zero. As with the first method, a positive $\gamma_{i,m}$ represents evidence in favour of market timing ability.

## 1.7 Research Overview

The research presented will concentrate on the moving average rule and its profitability in Developed Markets, US Industries, Cryptocurrency and Volatility Indices. The subsequent research is divided into five sections. Section 2 focuses on Developed Market quintiles using the intersections of 5x5 size and book-to-market independent sorts. Section 3 focuses on US Industry portfolios. Section 4 focuses on Cryptocurrency and Volatility Indices. Section 5 utilises the data of the previous sections focusing on changes to the [*f, d, h*] variables defined in Section 1.5 and how this alters the results. Section 6 concludes the research report, discussing the overarching findings and implications for future research.

# 2.0 Developed Market Indices and the Moving Average

## 2.1 Introduction

Prior research as discussed in Section 1.3 and 1.4 has shown the effectiveness of Technical Analysis, particularly the Moving Average (MA). The focus of research however has centred predominantly around the US market. This has the potential to overlook other markets performance in relation to the MA and their comparisons. Additionally, it is reasonable to assume given the size and popularity of the US market for investors, it would exhibit a higher level of price efficiency relative to other markets. Consequently, MA usage may be more beneficial to investors in smaller, less popular markets.

The purpose of research in Section 2 is to analyse and compare the MA performance of Developed Market Indices and respective quintile portfolios. The indices used and their composition can be seen in Section 2.2, Table 1. Value weighted and equal weighted results will also be analysed and compared. Changes in the MA indicator variables [*f, d, h*] and its effect on profitability will be analysed in Section 5.

## 2.2 Developed Markets Index Data

The data used in this section relates to six value and equal weighted indices: Developed, Developed excluding US, Japan, Asia Pacific excluding Japan, Europe and North America. Refer to Table 1 for a detailed list of which countries are included in which index.

**Table 1: Developed Market Indices & Compositions**

| Country | Developed | Developed excl. US | Japan | Asia Pacific excl. Japan | Europe | North America |
|---|---|---|---|---|---|---|
| Australia | ✓ | ✓ | | ✓ | | |
| Austria | ✓ | ✓ | | | ✓ | |
| Belgium | ✓ | ✓ | | | ✓ | |
| Canada | ✓ | ✓ | | | | ✓ |
| Switzerland | ✓ | ✓ | | | ✓ | |
| Germany | ✓ | ✓ | | | ✓ | |
| Denmark | ✓ | ✓ | | | ✓ | |
| Spain | ✓ | ✓ | | | ✓ | |
| Finland | ✓ | ✓ | | | ✓ | |
| France | ✓ | ✓ | | | ✓ | |
| Great Britain | ✓ | ✓ | | | ✓ | |
| Greece | ✓ | ✓ | | | ✓ | |
| Hong Kong | ✓ | ✓ | | ✓ | | |
| Ireland | ✓ | ✓ | | | ✓ | |
| Italy | ✓ | ✓ | | | ✓ | |
| Japan | ✓ | ✓ | ✓ | | | |
| Netherlands | ✓ | ✓ | | | ✓ | |
| Norway | ✓ | ✓ | | | ✓ | |
| New Zealand | ✓ | ✓ | | ✓ | | |
| Portugal | ✓ | ✓ | | | ✓ | |
| Sweden | ✓ | ✓ | | | ✓ | |
| Singapore | ✓ | ✓ | | ✓ | | |
| U.S. | ✓ | | | | | ✓ |

These indices are grouped into quintile portfolios created using the intersections of 5x5 size and book-to-market independent sorts. The data was sourced from the Kenneth R. French Data Library. At the time the data was sourced Developed was referred to as Global. The

paper has been updated to coincide with the change made in the Data Library. The time horizon for the data is January 1, 1991 to October 31, 2018 with daily returns used.

Using this data, the methodology described in Section 1.5 is used to create the CMA and associated TIS. The CMA created in Section 2 corresponds to [*f, d, h*] values [*0, 0, 0*] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held as discussed in Section 1.5. As previously mentioned, analysis of these variables and its effect on profitability when altered are included in Section 5.

The CMA and TIS are calculated for each portfolio in its respective index. This is completed twice, for value and equal weighted portfolios. Regression analysis is used following the methodology outlined in Section 1.6. The factors used in the regression models are all sourced from the Kenneth R. French Data Library. In total, 300 portfolios are analysed, with 25 portfolios for each of the 6 indices separated by weighting method.

The results are examined separately and then compared. Section 2.3 contains the value weighted results. Section 2.4 contains the equal weighted results. Section 2.5 compares the results of both weighting methods. Section 2.6 contains the robustness check, separating the time horizon into two sub-periods, January 1, 1991 to December 31, 2004 and January 3, 2005 to October 31, 2018.

## 2.3 Value Weighted Results

The results examined in this section relate to the indices weighted by value. This is the standard weighting system for indices, whereby the weight of each asset is found by taking the market capitalisation of the asset and dividing it by the total market capitalisation of all assets in the index.

### 2.3.1 Summary Statistics

The following tables (Table 2-7) report the summary statistics for the value weighted indices. Table 2 represents the Developed Index. Table 3 represents the Developed excluding US Index. Table 4 represents the Japan Index. Table 5 represents the Asia Pacific excluding Japan Index. Table 6 represents the Europe Index. Table 7 represents the North America Index. The country composition for each index is as seen in Table 1, Section 2.2.

Each table contains five important statistics for the Buy and Hold (BH), Moving Average (MA) and Technical Indicator Spread (TIS) portfolios: the mean return ($\mu$), standard deviation of returns ($\sigma$), skewness ($s$), kurtosis ($k$) and the Sharpe Ratio ($SR$). The $SR$ is found by $(\mu - r_f)/\sigma$ where $\mu$ is the mean return, $r_f$ is the risk-free return and $\sigma$ is the standard deviation of returns.

For the BH, MA and TIS the statistics are reported for each quintile portfolio. The quintiles are grouped by size with five categories (*Small*, *2*, *3*, *4* and *Big*). These five categories are grouped by book-to-market with five categories (*Low*, *2*, *3*, *4* and *High*). When analysing the results in the subsequent sections, the deciles will be referred to as *S-Low, S-2, S-3, S-4, S-High, 2-Low, 2-2……B-High*.

**Table 2: Summary Statistics for Value Weighted Developed Index**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 3.65 | 12.95 | -0.83 | 8.78 | 0.10 | 16.30 | 6.95 | -0.04 | 9.51 | 2.00 | 12.65 | 9.19 | 1.57 | 19.89 | 1.38 |
| | 2 | 6.71 | 11.74 | -0.85 | 9.28 | 0.37 | 16.58 | 6.46 | -0.08 | 8.57 | 2.20 | 9.88 | 8.23 | 1.67 | 24.11 | 1.20 |
| Small | 3 | 9.62 | 11.21 | -0.78 | 9.49 | 0.65 | 17.28 | 6.41 | -0.05 | 8.95 | 2.32 | 7.66 | 7.61 | 1.69 | 27.05 | 1.01 |
| | 4 | 10.32 | 10.38 | -0.80 | 9.03 | 0.76 | 16.80 | 6.03 | -0.07 | 7.97 | 2.39 | 6.49 | 6.95 | 1.91 | 27.17 | 0.93 |
| | High | 13.40 | 9.76 | -0.81 | 8.50 | 1.13 | 18.64 | 5.96 | -0.09 | 6.97 | 2.72 | 5.24 | 6.22 | 1.78 | 26.42 | 0.84 |
| | Low | 4.43 | 14.23 | -0.50 | 6.88 | 0.14 | 14.43 | 7.64 | -0.13 | 7.49 | 1.58 | 10.00 | 10.02 | 1.05 | 16.43 | 1.00 |
| | 2 | 7.44 | 13.06 | -0.59 | 8.08 | 0.39 | 14.82 | 7.22 | -0.24 | 7.45 | 1.72 | 7.38 | 9.05 | 1.24 | 22.33 | 0.82 |
| 2 | 3 | 8.61 | 12.37 | -0.45 | 7.94 | 0.50 | 13.86 | 7.12 | -0.12 | 9.18 | 1.61 | 5.25 | 8.33 | 1.02 | 22.71 | 0.63 |
| | 4 | 9.49 | 12.14 | -0.50 | 8.81 | 0.59 | 13.47 | 7.02 | -0.26 | 8.07 | 1.58 | 3.98 | 8.09 | 1.11 | 25.36 | 0.49 |
| | High | 10.41 | 12.11 | -0.45 | 7.49 | 0.66 | 14.77 | 7.12 | -0.11 | 7.35 | 1.74 | 4.37 | 7.94 | 1.07 | 21.44 | 0.55 |
| | Low | 5.68 | 15.00 | -0.39 | 7.32 | 0.22 | 13.45 | 8.05 | -0.31 | 7.94 | 1.37 | 7.77 | 10.58 | 0.71 | 17.77 | 0.73 |
| | 2 | 7.25 | 14.03 | -0.42 | 7.96 | 0.35 | 13.32 | 7.68 | -0.23 | 8.69 | 1.43 | 6.08 | 9.78 | 0.80 | 20.06 | 0.62 |
| 3 | 3 | 8.69 | 13.26 | -0.41 | 8.29 | 0.48 | 12.77 | 7.46 | -0.32 | 8.22 | 1.39 | 4.09 | 9.03 | 0.80 | 23.23 | 0.45 |
| | 4 | 8.98 | 12.88 | -0.42 | 9.16 | 0.51 | 12.67 | 7.32 | -0.39 | 10.29 | 1.40 | 3.70 | 8.74 | 0.75 | 25.15 | 0.42 |
| | High | 10.50 | 13.13 | -0.42 | 8.26 | 0.62 | 14.06 | 7.59 | -0.18 | 8.60 | 1.54 | 3.57 | 8.72 | 0.94 | 24.00 | 0.41 |
| | Low | 7.92 | 15.56 | -0.33 | 8.35 | 0.36 | 13.71 | 8.39 | -0.28 | 9.45 | 1.35 | 5.79 | 10.86 | 0.50 | 19.71 | 0.53 |
| | 2 | 8.23 | 13.70 | -0.33 | 9.20 | 0.43 | 11.78 | 7.62 | -0.27 | 8.94 | 1.23 | 3.56 | 9.48 | 0.51 | 25.30 | 0.38 |
| 4 | 3 | 8.46 | 13.51 | -0.37 | 9.54 | 0.45 | 12.23 | 7.47 | -0.31 | 9.88 | 1.32 | 3.77 | 9.33 | 0.61 | 25.88 | 0.40 |
| | 4 | 9.41 | 13.07 | -0.41 | 9.62 | 0.54 | 12.45 | 7.32 | -0.37 | 9.45 | 1.37 | 3.04 | 8.97 | 0.66 | 27.47 | 0.34 |
| | High | 9.83 | 13.95 | -0.40 | 11.12 | 0.53 | 13.34 | 7.73 | -0.33 | 9.99 | 1.42 | 3.51 | 9.68 | 0.67 | 32.44 | 0.36 |
| | Low | 7.78 | 14.98 | -0.07 | 11.64 | 0.36 | 8.62 | 8.03 | -0.35 | 7.94 | 0.78 | 0.85 | 10.54 | -0.28 | 32.79 | 0.08 |
| | 2 | 8.06 | 14.04 | -0.12 | 10.74 | 0.40 | 9.25 | 7.66 | -0.18 | 7.94 | 0.90 | 1.19 | 9.76 | -0.18 | 30.96 | 0.12 |
| Big | 3 | 8.30 | 14.53 | -0.27 | 10.79 | 0.41 | 9.46 | 7.88 | -0.37 | 8.55 | 0.90 | 1.16 | 10.09 | 0.13 | 28.43 | 0.11 |
| | 4 | 8.63 | 15.00 | 0.01 | 13.52 | 0.42 | 9.81 | 8.02 | -0.35 | 9.27 | 0.93 | 1.17 | 10.60 | -0.51 | 39.06 | 0.11 |
| | High | 8.59 | 17.77 | -0.18 | 13.82 | 0.35 | 10.81 | 9.27 | -0.40 | 14.05 | 0.91 | 2.23 | 12.65 | -0.01 | 32.85 | 0.18 |

**Table 3: Summary Statistics for Value Weighted Developed excl. US Index**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 3.28 | 12.87 | -0.80 | 8.69 | 0.07 | 15.93 | 7.10 | 0.13 | 9.75 | 1.91 | 12.66 | 8.98 | 1.68 | 19.99 | 1.41 |
| | 2 | 5.50 | 11.85 | -0.88 | 9.43 | 0.26 | 15.81 | 6.75 | -0.02 | 8.75 | 1.99 | 10.31 | 8.11 | 2.00 | 26.10 | 1.27 |
| Small | 3 | 7.77 | 11.24 | -0.91 | 9.24 | 0.48 | 15.69 | 6.52 | -0.09 | 8.48 | 2.04 | 7.92 | 7.60 | 2.18 | 27.90 | 1.04 |
| | 4 | 9.13 | 10.70 | -0.87 | 9.25 | 0.63 | 15.85 | 6.35 | -0.04 | 7.10 | 2.12 | 6.72 | 7.11 | 2.24 | 31.23 | 0.94 |
| | High | 11.88 | 10.50 | -0.77 | 9.47 | 0.90 | 17.14 | 6.50 | -0.05 | 6.48 | 2.27 | 5.27 | 6.68 | 1.70 | 33.45 | 0.79 |
| | Low | 2.65 | 13.85 | -0.58 | 7.70 | 0.02 | 13.90 | 7.52 | -0.11 | 8.46 | 1.53 | 11.25 | 9.71 | 1.23 | 18.34 | 1.16 |
| | 2 | 5.54 | 12.81 | -0.67 | 9.01 | 0.25 | 14.02 | 7.16 | -0.06 | 8.65 | 1.63 | 8.48 | 8.92 | 1.53 | 25.81 | 0.95 |
| 2 | 3 | 6.97 | 12.42 | -0.59 | 8.62 | 0.37 | 13.42 | 7.18 | -0.13 | 10.18 | 1.54 | 6.46 | 8.41 | 1.31 | 26.01 | 0.77 |
| | 4 | 8.36 | 12.00 | -0.57 | 7.82 | 0.50 | 13.76 | 7.01 | -0.15 | 7.47 | 1.62 | 5.40 | 8.02 | 1.39 | 24.78 | 0.67 |
| | High | 9.15 | 12.54 | -0.48 | 8.38 | 0.54 | 14.17 | 7.32 | -0.04 | 6.69 | 1.61 | 5.01 | 8.31 | 1.02 | 25.94 | 0.60 |
| | Low | 4.12 | 14.43 | -0.50 | 7.49 | 0.12 | 12.87 | 7.82 | -0.22 | 8.11 | 1.34 | 8.75 | 10.21 | 1.07 | 19.52 | 0.86 |
| | 2 | 5.97 | 13.64 | -0.60 | 8.93 | 0.26 | 12.61 | 7.55 | -0.32 | 9.96 | 1.35 | 6.64 | 9.50 | 1.24 | 24.88 | 0.70 |
| 3 | 3 | 6.51 | 13.44 | -0.37 | 10.04 | 0.31 | 11.60 | 7.51 | -0.37 | 10.40 | 1.23 | 5.09 | 9.30 | 0.49 | 29.76 | 0.55 |
| | 4 | 7.70 | 13.29 | -0.43 | 9.68 | 0.40 | 11.87 | 7.67 | -0.58 | 14.34 | 1.24 | 4.17 | 9.00 | 0.60 | 28.46 | 0.46 |
| | High | 9.17 | 13.62 | -0.34 | 7.81 | 0.50 | 13.89 | 7.94 | 0.00 | 7.36 | 1.45 | 4.72 | 9.01 | 0.78 | 24.52 | 0.52 |
| | Low | 5.03 | 15.20 | -0.36 | 8.17 | 0.17 | 11.80 | 8.33 | -0.33 | 9.42 | 1.13 | 6.78 | 10.62 | 0.73 | 20.89 | 0.64 |
| | 2 | 7.01 | 14.22 | -0.36 | 8.34 | 0.33 | 11.01 | 8.07 | -0.15 | 8.11 | 1.07 | 4.01 | 9.71 | 0.74 | 24.25 | 0.41 |
| 4 | 3 | 7.33 | 14.26 | -0.34 | 8.13 | 0.35 | 10.89 | 8.01 | -0.25 | 9.07 | 1.06 | 3.57 | 9.78 | 0.60 | 22.69 | 0.36 |
| | 4 | 7.92 | 13.91 | -0.34 | 7.80 | 0.40 | 11.03 | 7.90 | -0.35 | 10.49 | 1.09 | 3.11 | 9.46 | 0.59 | 22.00 | 0.33 |
| | High | 7.98 | 14.88 | -0.30 | 8.29 | 0.38 | 12.78 | 8.32 | -0.09 | 8.79 | 1.25 | 4.80 | 10.21 | 0.60 | 23.51 | 0.47 |
| | Low | 4.75 | 16.71 | -0.06 | 9.12 | 0.14 | 7.82 | 8.99 | -0.21 | 8.76 | 0.60 | 3.07 | 11.84 | -0.06 | 24.03 | 0.26 |
| | 2 | 6.68 | 15.86 | -0.09 | 8.09 | 0.27 | 7.92 | 8.89 | -0.04 | 9.88 | 0.62 | 1.23 | 10.91 | -0.06 | 23.03 | 0.11 |
| Big | 3 | 6.98 | 16.11 | -0.16 | 10.03 | 0.29 | 8.35 | 8.75 | -0.26 | 9.67 | 0.68 | 1.36 | 11.27 | -0.03 | 28.31 | 0.12 |
| | 4 | 8.10 | 16.88 | -0.07 | 10.53 | 0.34 | 9.31 | 9.26 | -0.34 | 10.88 | 0.75 | 1.21 | 11.79 | -0.18 | 31.18 | 0.10 |
| | High | 8.21 | 19.82 | -0.05 | 11.12 | 0.29 | 9.80 | 10.62 | -0.34 | 15.16 | 0.70 | 1.59 | 14.02 | -0.25 | 29.08 | 0.11 |

**Table 4: Summary Statistics for Value Weighted Japan Index**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 5.88 | 22.56 | -0.50 | 10.50 | 0.16 | 20.56 | 12.65 | -0.22 | 13.11 | 1.44 | 14.68 | 15.16 | 0.75 | 22.20 | 0.97 |
| | 2 | 6.15 | 19.54 | -0.54 | 11.84 | 0.19 | 15.90 | 11.03 | -0.22 | 9.58 | 1.23 | 9.75 | 12.91 | 0.45 | 25.17 | 0.76 |
| Small | 3 | 6.52 | 18.91 | -0.44 | 10.27 | 0.22 | 15.59 | 10.79 | -0.16 | 9.17 | 1.22 | 9.07 | 12.51 | 0.81 | 27.02 | 0.72 |
| | 4 | 6.85 | 17.77 | -0.31 | 10.35 | 0.25 | 14.66 | 10.10 | -0.19 | 8.33 | 1.22 | 7.81 | 11.80 | 0.22 | 26.20 | 0.66 |
| | High | 8.08 | 17.15 | -0.32 | 10.47 | 0.33 | 15.54 | 9.99 | -0.18 | 8.90 | 1.32 | 7.46 | 11.06 | 0.14 | 25.23 | 0.67 |
| | Low | 5.52 | 23.81 | -0.25 | 9.39 | 0.13 | 16.16 | 13.46 | 0.44 | 16.02 | 1.02 | 10.64 | 16.01 | 0.37 | 18.31 | 0.66 |
| | 2 | 2.25 | 20.77 | -0.28 | 8.51 | -0.01 | 10.44 | 11.20 | -0.25 | 8.76 | 0.72 | 8.18 | 14.34 | 0.40 | 19.17 | 0.57 |
| 2 | 3 | 3.66 | 19.65 | -0.12 | 9.25 | 0.07 | 9.38 | 10.69 | -0.18 | 8.53 | 0.66 | 5.72 | 13.54 | 0.00 | 23.14 | 0.42 |
| | 4 | 5.72 | 19.66 | -0.18 | 8.81 | 0.17 | 9.25 | 11.00 | -0.47 | 9.26 | 0.62 | 3.53 | 13.30 | -0.02 | 22.27 | 0.27 |
| | High | 5.36 | 20.04 | -0.12 | 9.28 | 0.15 | 9.44 | 11.07 | -0.15 | 8.27 | 0.64 | 4.08 | 13.55 | -0.07 | 21.40 | 0.30 |
| | Low | 0.43 | 22.57 | -0.22 | 7.35 | -0.09 | 10.14 | 11.68 | -0.20 | 8.97 | 0.66 | 9.72 | 16.11 | 0.34 | 16.42 | 0.60 |
| | 2 | 3.68 | 21.55 | -0.18 | 8.47 | 0.06 | 6.72 | 11.44 | -0.22 | 7.80 | 0.38 | 3.04 | 15.09 | 0.09 | 19.60 | 0.20 |
| 3 | 3 | 3.89 | 20.72 | -0.09 | 8.49 | 0.07 | 6.48 | 11.23 | -0.27 | 7.78 | 0.37 | 2.58 | 14.25 | -0.15 | 20.17 | 0.18 |
| | 4 | 4.57 | 20.26 | -0.10 | 7.94 | 0.11 | 5.08 | 11.18 | -0.38 | 7.95 | 0.24 | 0.51 | 13.86 | -0.02 | 20.28 | 0.04 |
| | High | 6.65 | 20.91 | 0.02 | 8.64 | 0.20 | 7.10 | 11.86 | -0.05 | 7.80 | 0.40 | 0.45 | 13.88 | -0.17 | 21.69 | 0.03 |
| | Low | 1.09 | 22.87 | -0.06 | 7.32 | -0.06 | 6.38 | 11.85 | -0.21 | 8.84 | 0.34 | 5.29 | 16.27 | -0.15 | 16.19 | 0.32 |
| | 2 | 4.27 | 21.55 | -0.03 | 7.76 | 0.09 | 2.75 | 11.82 | -0.35 | 7.63 | 0.03 | -1.52 | 14.79 | -0.18 | 18.22 | -0.10 |
| 4 | 3 | 4.37 | 20.84 | -0.05 | 7.73 | 0.10 | 1.50 | 11.46 | -0.28 | 9.03 | -0.08 | -2.87 | 14.26 | -0.10 | 16.82 | -0.20 |
| | 4 | 5.83 | 20.96 | -0.04 | 7.92 | 0.16 | 2.97 | 11.67 | -0.29 | 7.81 | 0.05 | -2.86 | 14.13 | -0.29 | 19.04 | -0.20 |
| | High | 6.15 | 22.20 | 0.08 | 8.16 | 0.17 | 3.53 | 12.46 | -0.27 | 9.14 | 0.09 | -2.62 | 14.86 | -0.33 | 18.20 | -0.18 |
| | Low | 2.71 | 24.33 | 0.18 | 7.79 | 0.01 | 1.03 | 13.07 | -0.08 | 9.37 | -0.10 | -1.68 | 17.06 | -0.46 | 15.87 | -0.10 |
| | 2 | 4.02 | 22.38 | 0.16 | 8.21 | 0.07 | -0.75 | 12.34 | -0.03 | 9.58 | -0.25 | -4.77 | 15.42 | -0.47 | 19.38 | -0.31 |
| Big | 3 | 4.65 | 22.70 | 0.17 | 9.43 | 0.10 | 1.08 | 12.36 | 0.05 | 8.10 | -0.11 | -3.57 | 15.62 | -0.56 | 21.18 | -0.23 |
| | 4 | 6.17 | 22.58 | 0.11 | 6.89 | 0.17 | 0.43 | 12.67 | 0.03 | 8.19 | -0.15 | -5.74 | 15.21 | -0.37 | 16.35 | -0.38 |
| | High | 8.83 | 25.78 | 0.28 | 9.19 | 0.25 | 2.94 | 14.74 | 0.35 | 11.17 | 0.04 | -5.89 | 17.21 | -0.63 | 22.55 | -0.34 |

**Table 5: Summary Statistics for Value Weighted Asia Pacific excl. Japan Index**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 5.77 | 18.22 | -0.73 | 17.00 | 0.19 | 22.08 | 11.00 | 1.45 | 27.47 | 1.79 | 16.31 | 12.12 | 3.11 | 54.17 | 1.35 |
| | 2 | 4.68 | 16.47 | -1.35 | 18.15 | 0.14 | 20.68 | 9.29 | 0.33 | 10.53 | 1.97 | 16.01 | 11.44 | 3.02 | 46.09 | 1.40 |
| Small | 3 | 8.69 | 15.86 | -1.26 | 17.51 | 0.40 | 21.48 | 9.14 | 0.23 | 11.29 | 2.09 | 12.80 | 10.73 | 3.03 | 49.58 | 1.19 |
| | 4 | 12.58 | 14.40 | -1.14 | 14.25 | 0.71 | 24.05 | 8.92 | 0.51 | 9.62 | 2.43 | 11.46 | 9.24 | 3.30 | 45.52 | 1.24 |
| | High | 17.02 | 13.59 | -1.18 | 13.69 | 1.08 | 28.42 | 8.81 | 0.38 | 11.04 | 2.96 | 11.41 | 8.21 | 3.25 | 42.18 | 1.39 |
| | Low | -0.54 | 16.37 | -1.01 | 12.42 | -0.18 | 14.41 | 8.38 | 0.25 | 10.45 | 1.44 | 14.95 | 12.06 | 2.23 | 31.72 | 1.24 |
| | 2 | 3.51 | 16.77 | -0.91 | 12.40 | 0.07 | 17.60 | 9.12 | 0.06 | 13.05 | 1.67 | 14.09 | 11.99 | 2.05 | 34.25 | 1.18 |
| 2 | 3 | 5.38 | 15.41 | -0.90 | 11.54 | 0.19 | 16.99 | 8.43 | 0.20 | 8.07 | 1.73 | 11.61 | 10.94 | 2.36 | 34.37 | 1.06 |
| | 4 | 7.95 | 15.48 | -0.98 | 12.04 | 0.36 | 19.43 | 8.73 | 0.07 | 10.61 | 1.95 | 11.48 | 10.77 | 2.37 | 37.09 | 1.07 |
| | High | 11.12 | 16.13 | -0.74 | 13.03 | 0.54 | 22.57 | 9.76 | 0.58 | 18.66 | 2.07 | 11.45 | 10.39 | 2.51 | 36.18 | 1.10 |
| | Low | 2.97 | 18.22 | -0.71 | 13.41 | 0.03 | 15.67 | 9.59 | -0.16 | 10.59 | 1.39 | 12.71 | 13.28 | 1.43 | 38.13 | 0.96 |
| | 2 | 5.97 | 16.95 | -0.76 | 11.71 | 0.21 | 15.47 | 9.45 | 0.21 | 11.94 | 1.39 | 9.50 | 11.86 | 2.18 | 35.83 | 0.80 |
| 3 | 3 | 10.01 | 16.73 | -0.74 | 12.17 | 0.46 | 18.12 | 9.45 | 0.24 | 9.43 | 1.66 | 8.11 | 11.57 | 1.84 | 37.74 | 0.70 |
| | 4 | 9.27 | 15.37 | -0.87 | 12.28 | 0.45 | 18.48 | 8.84 | 0.36 | 10.76 | 1.82 | 9.21 | 10.55 | 2.71 | 40.75 | 0.87 |
| | High | 9.98 | 16.21 | -0.81 | 12.47 | 0.47 | 20.58 | 9.48 | 0.24 | 13.85 | 1.92 | 10.60 | 10.90 | 2.59 | 37.87 | 0.97 |
| | Low | 9.05 | 17.36 | -0.70 | 12.66 | 0.38 | 15.41 | 9.66 | 0.08 | 7.89 | 1.35 | 6.36 | 12.18 | 1.86 | 39.74 | 0.52 |
| | 2 | 10.56 | 16.35 | -0.75 | 13.39 | 0.50 | 16.00 | 9.36 | 0.02 | 11.69 | 1.45 | 5.43 | 11.15 | 1.74 | 38.91 | 0.49 |
| 4 | 3 | 8.82 | 18.04 | 2.99 | 183.07 | 0.36 | 14.15 | 10.13 | -6.73 | 265.70 | 1.16 | 5.33 | 12.97 | -11.43 | 582.94 | 0.41 |
| | 4 | 12.17 | 16.62 | -0.63 | 10.25 | 0.59 | 17.39 | 9.64 | -0.05 | 7.30 | 1.56 | 5.22 | 11.23 | 1.76 | 33.45 | 0.46 |
| | High | 12.37 | 18.24 | -0.53 | 10.45 | 0.55 | 21.09 | 10.94 | 0.21 | 14.39 | 1.71 | 8.72 | 11.93 | 1.68 | 29.11 | 0.73 |
| | Low | 8.76 | 20.46 | -0.10 | 12.53 | 0.31 | 12.55 | 10.84 | 0.12 | 7.51 | 0.94 | 3.79 | 14.62 | 0.26 | 36.28 | 0.26 |
| | 2 | 10.99 | 18.33 | -0.12 | 13.40 | 0.47 | 13.61 | 10.12 | 0.16 | 7.20 | 1.11 | 2.62 | 12.80 | 0.26 | 43.73 | 0.20 |
| Big | 3 | 11.38 | 19.15 | -0.04 | 11.05 | 0.47 | 13.80 | 10.72 | 0.24 | 8.23 | 1.06 | 2.42 | 13.09 | 0.26 | 34.44 | 0.18 |
| | 4 | 11.10 | 18.43 | -0.09 | 8.43 | 0.47 | 14.40 | 10.65 | 0.20 | 9.15 | 1.13 | 3.30 | 12.30 | 0.50 | 23.58 | 0.27 |
| | High | 13.05 | 22.26 | 0.25 | 12.24 | 0.48 | 17.85 | 13.16 | 0.92 | 17.84 | 1.18 | 4.81 | 14.47 | 0.30 | 29.20 | 0.33 |

**Table 6: Summary Statistics for Value Weighted Europe Index**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 1.43 | 13.90 | -0.63 | 8.19 | -0.07 | 12.29 | 7.77 | -0.30 | 15.83 | 1.28 | 10.86 | 9.64 | 1.18 | 17.85 | 1.13 |
| | 2 | 6.25 | 13.25 | -0.69 | 8.36 | 0.29 | 14.49 | 7.74 | -0.41 | 13.77 | 1.57 | 8.25 | 8.91 | 1.49 | 22.20 | 0.93 |
| Small | 3 | 7.24 | 12.75 | -0.61 | 8.85 | 0.38 | 13.67 | 7.65 | -0.44 | 12.84 | 1.48 | 6.43 | 8.37 | 1.42 | 24.06 | 0.77 |
| | 4 | 8.72 | 12.29 | -0.65 | 8.37 | 0.52 | 14.59 | 7.48 | -0.34 | 11.41 | 1.63 | 5.86 | 7.98 | 1.66 | 26.97 | 0.73 |
| | High | 10.70 | 11.89 | -0.58 | 7.54 | 0.70 | 15.72 | 7.44 | -0.18 | 9.57 | 1.79 | 5.02 | 7.55 | 1.53 | 26.06 | 0.67 |
| | Low | 5.26 | 15.67 | -0.40 | 9.12 | 0.18 | 13.52 | 8.83 | -0.30 | 12.53 | 1.26 | 8.26 | 10.71 | 0.80 | 22.21 | 0.77 |
| | 2 | 7.57 | 14.74 | -0.52 | 8.30 | 0.35 | 13.38 | 8.55 | -0.32 | 11.03 | 1.29 | 5.81 | 9.89 | 1.05 | 24.11 | 0.59 |
| 2 | 3 | 8.26 | 14.25 | -0.56 | 8.88 | 0.41 | 13.29 | 8.41 | -0.64 | 14.67 | 1.30 | 5.03 | 9.48 | 1.01 | 25.96 | 0.53 |
| | 4 | 9.98 | 14.26 | -0.53 | 9.97 | 0.53 | 14.40 | 8.48 | -0.34 | 10.45 | 1.42 | 4.42 | 9.42 | 1.13 | 32.88 | 0.47 |
| | High | 10.74 | 14.63 | -0.49 | 8.42 | 0.57 | 15.18 | 8.73 | -0.32 | 10.37 | 1.47 | 4.44 | 9.62 | 1.08 | 26.37 | 0.46 |
| | Low | 6.37 | 17.29 | -0.42 | 8.75 | 0.23 | 11.75 | 9.61 | -0.60 | 14.43 | 0.97 | 5.38 | 11.99 | 0.65 | 21.82 | 0.45 |
| | 2 | 8.64 | 16.43 | -0.47 | 9.82 | 0.38 | 12.55 | 9.38 | -0.58 | 12.69 | 1.08 | 3.91 | 11.17 | 0.73 | 27.90 | 0.35 |
| 3 | 3 | 8.48 | 15.80 | -0.41 | 9.40 | 0.39 | 11.53 | 8.98 | -0.51 | 11.30 | 1.02 | 3.05 | 10.68 | 0.48 | 26.08 | 0.29 |
| | 4 | 8.63 | 16.04 | -0.34 | 12.68 | 0.39 | 11.47 | 9.38 | -0.72 | 36.29 | 0.97 | 2.84 | 10.73 | 0.43 | 24.99 | 0.26 |
| | High | 10.82 | 16.44 | -0.36 | 8.88 | 0.51 | 14.81 | 9.43 | -0.32 | 11.20 | 1.32 | 3.99 | 11.13 | 0.57 | 25.37 | 0.36 |
| | Low | 8.54 | 18.02 | -0.24 | 9.15 | 0.34 | 10.31 | 10.09 | -0.61 | 13.61 | 0.79 | 1.77 | 12.43 | 0.17 | 24.29 | 0.14 |
| | 2 | 8.81 | 16.89 | -0.29 | 10.48 | 0.38 | 9.26 | 9.53 | -0.53 | 10.51 | 0.72 | 0.45 | 11.61 | 0.27 | 30.92 | 0.04 |
| 4 | 3 | 9.29 | 17.04 | -0.20 | 9.87 | 0.41 | 9.75 | 9.67 | -0.44 | 12.09 | 0.76 | 0.47 | 11.57 | -0.07 | 28.51 | 0.04 |
| | 4 | 9.09 | 17.38 | -0.31 | 10.83 | 0.39 | 10.82 | 9.67 | -0.79 | 16.43 | 0.87 | 1.72 | 12.01 | 0.04 | 28.89 | 0.14 |
| | High | 10.21 | 18.93 | -0.30 | 10.97 | 0.41 | 13.07 | 10.24 | -0.37 | 10.69 | 1.04 | 2.86 | 13.25 | 0.14 | 29.52 | 0.22 |
| | Low | 7.15 | 18.89 | 0.06 | 10.84 | 0.25 | 4.65 | 10.17 | -0.41 | 8.41 | 0.22 | -2.51 | 13.33 | -0.65 | 31.15 | -0.19 |
| | 2 | 8.93 | 17.94 | 0.01 | 9.40 | 0.37 | 5.77 | 10.05 | -0.35 | 8.35 | 0.34 | -3.16 | 12.28 | -0.58 | 29.11 | -0.26 |
| Big | 3 | 9.20 | 19.34 | -0.04 | 10.59 | 0.35 | 7.19 | 10.56 | -0.44 | 10.25 | 0.46 | -2.01 | 13.39 | -0.54 | 30.61 | -0.15 |
| | 4 | 10.51 | 20.64 | 0.08 | 11.89 | 0.39 | 7.06 | 11.33 | -0.66 | 13.37 | 0.41 | -3.45 | 14.36 | -0.90 | 34.79 | -0.24 |
| | High | 8.75 | 23.22 | 0.03 | 11.78 | 0.27 | 8.42 | 12.15 | -0.70 | 19.44 | 0.50 | -0.33 | 16.59 | -0.56 | 28.74 | -0.02 |

**Table 7: Summary Statistics for Value Weighted North America Index**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 6.96 | 21.73 | -0.51 | 8.75 | 0.21 | 16.06 | 11.44 | -0.34 | 8.77 | 1.20 | 9.10 | 15.31 | 0.62 | 19.62 | 0.59 |
| | 2 | 9.73 | 19.79 | -0.50 | 8.86 | 0.37 | 14.79 | 10.74 | -0.38 | 8.35 | 1.16 | 5.06 | 13.75 | 0.61 | 21.61 | 0.37 |
| Small | 3 | 13.31 | 18.54 | -0.38 | 9.66 | 0.59 | 15.42 | 10.63 | -0.14 | 14.86 | 1.23 | 2.11 | 12.34 | 0.52 | 24.78 | 0.17 |
| | 4 | 12.65 | 16.83 | -0.44 | 9.16 | 0.61 | 13.39 | 9.52 | -0.37 | 8.09 | 1.16 | 0.75 | 11.27 | 0.59 | 24.65 | 0.07 |
| | High | 16.04 | 16.23 | -0.54 | 12.01 | 0.84 | 17.25 | 9.26 | -0.53 | 9.21 | 1.61 | 1.21 | 10.82 | 0.82 | 33.23 | 0.11 |
| | Low | 7.30 | 23.28 | -0.24 | 7.03 | 0.21 | 10.87 | 12.09 | -0.46 | 7.03 | 0.70 | 3.57 | 16.63 | 0.19 | 17.05 | 0.21 |
| | 2 | 10.14 | 20.98 | -0.24 | 7.33 | 0.37 | 10.75 | 11.38 | -0.28 | 7.12 | 0.74 | 0.61 | 14.49 | 0.19 | 18.21 | 0.04 |
| 2 | 3 | 12.50 | 19.13 | -0.25 | 7.75 | 0.53 | 9.61 | 10.91 | -0.29 | 7.93 | 0.66 | -2.89 | 12.77 | 0.19 | 21.15 | -0.23 |
| | 4 | 12.24 | 18.34 | -0.28 | 9.71 | 0.54 | 8.75 | 10.29 | -0.50 | 8.10 | 0.62 | -3.48 | 12.30 | 0.07 | 25.56 | -0.28 |
| | High | 12.93 | 18.81 | -0.35 | 11.08 | 0.56 | 10.64 | 10.51 | -0.59 | 9.51 | 0.79 | -2.29 | 12.66 | 0.24 | 28.32 | -0.18 |
| | Low | 12.02 | 22.91 | -0.20 | 8.50 | 0.42 | 12.78 | 12.30 | -0.27 | 8.21 | 0.85 | 0.76 | 15.92 | -0.03 | 19.52 | 0.05 |
| | 2 | 10.70 | 19.88 | -0.22 | 9.11 | 0.42 | 10.22 | 10.56 | -0.35 | 7.17 | 0.74 | -0.48 | 13.89 | 0.01 | 23.00 | -0.03 |
| 3 | 3 | 11.95 | 17.93 | -0.28 | 8.43 | 0.53 | 9.84 | 10.07 | -0.41 | 7.10 | 0.74 | -2.11 | 12.06 | 0.24 | 23.28 | -0.18 |
| | 4 | 11.46 | 17.18 | -0.34 | 9.76 | 0.53 | 9.51 | 9.57 | -0.45 | 7.96 | 0.74 | -1.95 | 11.66 | 0.32 | 26.88 | -0.17 |
| | High | 13.22 | 17.97 | -0.43 | 11.42 | 0.60 | 11.42 | 10.10 | -0.67 | 9.50 | 0.90 | -1.80 | 12.08 | 0.51 | 32.43 | -0.15 |
| | Low | 12.68 | 23.02 | 0.03 | 10.44 | 0.45 | 11.84 | 12.28 | -0.19 | 9.46 | 0.77 | -0.84 | 16.10 | -0.42 | 25.63 | -0.05 |
| | 2 | 11.02 | 18.59 | -0.22 | 10.08 | 0.46 | 8.61 | 10.17 | -0.41 | 8.34 | 0.61 | -2.41 | 12.84 | 0.05 | 26.67 | -0.19 |
| 4 | 3 | 12.11 | 17.17 | -0.31 | 10.67 | 0.57 | 9.35 | 9.66 | -0.49 | 7.92 | 0.72 | -2.76 | 11.57 | 0.16 | 31.22 | -0.24 |
| | 4 | 11.54 | 16.82 | -0.37 | 13.87 | 0.54 | 10.22 | 9.15 | -0.52 | 8.63 | 0.86 | -1.33 | 11.65 | 0.26 | 40.21 | -0.11 |
| | High | 12.73 | 17.96 | -0.41 | 15.32 | 0.58 | 11.33 | 9.88 | -0.66 | 12.41 | 0.91 | -1.41 | 12.32 | 0.24 | 40.29 | -0.11 |
| | Low | 10.71 | 18.18 | 0.09 | 11.62 | 0.46 | 5.86 | 9.89 | -0.40 | 7.61 | 0.35 | -4.86 | 12.58 | -0.94 | 35.50 | -0.39 |
| | 2 | 10.87 | 16.66 | 0.01 | 11.50 | 0.51 | 6.05 | 9.03 | -0.35 | 6.71 | 0.41 | -4.82 | 11.46 | -0.79 | 33.80 | -0.42 |
| Big | 3 | 10.30 | 17.28 | -0.24 | 12.21 | 0.46 | 5.91 | 9.36 | -0.45 | 8.13 | 0.38 | -4.39 | 11.96 | -0.17 | 32.68 | -0.37 |
| | 4 | 10.38 | 17.03 | -0.12 | 12.56 | 0.47 | 6.56 | 9.20 | -0.46 | 8.76 | 0.45 | -3.82 | 11.83 | -0.42 | 33.97 | -0.32 |
| | High | 10.21 | 21.24 | -0.20 | 18.07 | 0.37 | 6.68 | 10.77 | -0.97 | 14.67 | 0.40 | -3.53 | 15.25 | -0.27 | 41.23 | -0.23 |

The Developed Index including and excluding the US (refer to Table 2 and 3) clearly shows a sizeable reduction in risk relative to return when utilising the MA portfolio. This is most evident when reviewing the *SR*s, which are higher for all MA quintiles compared to the BH. This is an important observation as it implies the risk-return profile of the MA portfolio is superior to the BH portfolio.

In regard to size and book-to-market relative to performance, there is a clear reduction is performance as the size of the quintiles increase, with small asset quintile MA performance far superior to big asset quintile MA performance relative to the BH. There is less of a clear relationship between book-to-market and performance, with a slightly higher performance for higher levels of book-to-market, although this is not always consistent across quintiles. Interestingly, where performance does increase for higher book-to-market quintiles, risk decreases, thus improving the *SR*. This becomes less pronounced as firm size increases.

Finally, when comparing Table 2 and 3, there is very little difference when excluding US stocks, with only a small drop in performance across all quintiles. This indicates the US is not a large contributor to the overall performance of the Developed Index MA performance.

The Japan Index (refer to Table 4) clearly shows a reduction in risk relative to return when utilising the MA portfolio, although this does not hold for the biggest quintiles (*4-2* to *B-High)*. This is most evident when reviewing the Sharpe Ratios for the MA and TIS portfolios, with performance decreasing as size increases. Book-to-market and performance follows from the Developed Indices with perhaps a slightly higher performance for higher levels of book-to-market, although this is even less consistent across quintiles than the previous results.

The Asia Pacific excluding Japan Index (refer to Table 5) clearly shows a reduction in risk relative to return when utilising the MA portfolio. It has the highest performance when compared to the four indices which make up the Developed Index (Asia Pacific excluding Japan, Japan, North America and Europe).

The most interesting observation is the lack performance drop off as size increases. It is the only index of the four where the MA improves performance over the BH for all quintiles. This indicates the results in Developed including and excluding the US, particularly for bigger size quintiles, is driven by the performance of the Asia Pacific excluding Japan Index. In addition, there is a clear increase in performance for higher levels of book-to-market, consistent across all quintiles irrespective of size.

The Europe Index (refer to Table 6) has similar characteristics to the Asia Pacific excluding Japan Index, although there is a significant performance reduction for the biggest quintiles with the MA underperforming relative to the BH. The MA performance relative to the BH appears to be less pronounced for the Europe Index, although still effective for small capitalised stocks. Performance continues to marginally improve for higher levels of book-to-market.

The North America Index (refer to Table 7) has the least consistent performance for the MA relative to the BH. Only the smallest quintiles achieve improved performance when using the MA. The MA even achieves a lower return for Quintile *2-3*, which is completely contrary to all other results. This indicates that the North American Index plays a significant role in reducing performance of the overall Developed result for the larger size quintiles.

The results across all six tables show a clear increase in average returns for the MA portfolio relative to the BH, with a maximum increase of 16.31%. There is also a clear reduction in the

standard deviation of returns. This is evident when comparing the Sharpe Ratio for the BH, MA and TIS and also across quintiles. The result diminishes the larger the size and higher the book-to-market for the portfolio in majority of cases, consistent with results found by Glabadanidis (2017) who found a negative relationship between size and TA performance and a positive relationship between book-to-market and TA performance.

The summary statistics show what appears to be a significant increase in performance when using the MA. Section 2.3.2 will determine if this difference in performance is statistically significant.

### 2.3.2 Factor Regression Analysis

Regression analysis was performed using model (1), (2) and (3) from Section 1.6. However, only model (3) will be shown and discussed in this section as the other results do not alter nor add anything to the analysis.

The following tables (Table 8-13) contain the results when regressing the TIS excess returns using the Carhart 4-factor model. The results are tested for statistical significance at the 90%, 95% and 99% confidence, corresponding to *, ** and *** respectively.

The Developed Index in Table 8 shows a clear statistically significant excess return with all except one alpha corresponding to a 99% confidence level, with abnormal returns ranging from 3.747% to 15.534% per annum. The results support the findings in the summary statistics relating to size, with excess returns declining significantly as size increases, albeit remaining above zero for all quintiles. Furthermore, for the smallest size groupings, excess returns diminish as book-to-market increases. When reviewing this in conjunction with the summary statistics, it is caused by the BH considerably outperforming at higher levels of

book-to-market for each size category. Excess returns appear to reverse the relationship for the biggest quintiles, with performance slightly increasing as book-to-market increases.

**Table 8: Factor Regression Results for Value Weighted Developed Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 15.534*** | -0.607*** | -0.649*** | 0.163*** | 0.006 | 0.642 |
| | 2 | 12.655*** | -0.548*** | -0.539*** | 0.093*** | 0.008 | 0.642 |
| Small | 3 | 10.580*** | -0.513*** | -0.485*** | 0.020* | -0.005 | 0.641 |
| | 4 | 9.538*** | -0.475*** | -0.451*** | -0.075*** | -0.007 | 0.648 |
| | High | 8.288*** | -0.416*** | -0.449*** | -0.154*** | -0.015*** | 0.617 |
| | Low | 12.512*** | -0.671*** | -0.561*** | 0.315*** | 0.036*** | 0.710 |
| | 2 | 10.008*** | -0.608*** | -0.452*** | 0.161*** | 0.045*** | 0.693 |
| 2 | 3 | 8.188*** | -0.567*** | -0.406*** | 0.027** | 0.036*** | 0.689 |
| | 4 | 7.411*** | -0.548*** | -0.372*** | -0.121*** | 0.025*** | 0.676 |
| | High | 8.339*** | -0.545*** | -0.429*** | -0.242*** | 0.006 | 0.679 |
| | Low | 9.873*** | -0.675*** | -0.415*** | 0.382*** | 0.065*** | 0.698 |
| | 2 | 8.945*** | -0.644*** | -0.358*** | 0.189*** | 0.027*** | 0.697 |
| 3 | 3 | 7.089*** | -0.590*** | -0.281*** | 0.013 | 0.055*** | 0.686 |
| | 4 | 7.300*** | -0.572*** | -0.259*** | -0.149*** | 0.036*** | 0.682 |
| | High | 7.764*** | -0.577*** | -0.296*** | -0.285*** | 0.024*** | 0.686 |
| | Low | 7.860*** | -0.662*** | -0.256*** | 0.403*** | 0.049*** | 0.687 |
| | 2 | 6.299*** | -0.595*** | -0.180*** | 0.115*** | 0.045*** | 0.686 |
| 4 | 3 | 7.260*** | -0.597*** | -0.166*** | -0.058*** | 0.027*** | 0.693 |
| | 4 | 6.867*** | -0.566*** | -0.158*** | -0.192*** | 0.021*** | 0.671 |
| | High | 7.866*** | -0.605*** | -0.145*** | -0.309*** | 0.037*** | 0.686 |
| | Low | 1.435 | -0.523*** | 0.191*** | 0.526*** | 0.086*** | 0.706 |
| | 2 | 3.747*** | -0.533*** | 0.197*** | 0.146*** | 0.003 | 0.709 |
| Big | 3 | 4.511*** | -0.580*** | 0.121*** | -0.045*** | 0.027*** | 0.708 |
| | 4 | 5.145*** | -0.597*** | 0.159*** | -0.195*** | 0.030*** | 0.700 |
| | High | 6.960*** | -0.700*** | 0.166*** | -0.370*** | 0.098*** | 0.701 |

The Developed Index excluding US in Table 9 shows a clear statistically significant excess return with all except three alphas corresponding to a 99% confidence level with the other three all significant at 90%. The abnormal returns range from 2.085% to 13.837% per annum. The results are all consistent with the findings of Table 8. The only difference is the slight reduction in excess return performance when excluding the US.

**Table 9: Factor Regression Results for Value Weighted Developed excl. US Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 13.837*** | -0.587*** | -0.561*** | 0.257*** | 0.024*** | 0.652 |
| | 2 | 11.795*** | -0.532*** | -0.493*** | 0.146*** | 0.019** | 0.636 |
| Small | 3 | 9.582*** | -0.501*** | -0.460*** | 0.084*** | 0.015** | 0.633 |
| | 4 | 8.678*** | -0.477*** | -0.455*** | -0.002 | 0.013* | 0.636 |
| | High | 7.602*** | -0.451*** | -0.499*** | -0.086*** | -0.001 | 0.622 |
| | Low | 12.027*** | -0.637*** | -0.538*** | 0.342*** | 0.055*** | 0.694 |
| | 2 | 9.630*** | -0.584*** | -0.475*** | 0.187*** | 0.071*** | 0.670 |
| 2 | 3 | 8.427*** | -0.567*** | -0.474*** | 0.041*** | 0.039*** | 0.671 |
| | 4 | 7.843*** | -0.546*** | -0.475*** | -0.072*** | 0.032*** | 0.668 |
| | High | 8.175*** | -0.567*** | -0.534*** | -0.174*** | 0.009 | 0.651 |
| | Low | 9.329*** | -0.632*** | -0.396*** | 0.356*** | 0.071*** | 0.676 |
| | 2 | 8.330*** | -0.608*** | -0.378*** | 0.113*** | 0.056*** | 0.673 |
| 3 | 3 | 7.023*** | -0.592*** | -0.373*** | 0.020 | 0.071*** | 0.658 |
| | 4 | 6.748*** | -0.580*** | -0.391*** | -0.095*** | 0.047*** | 0.647 |
| | High | 7.913*** | -0.591*** | -0.399*** | -0.193*** | 0.030*** | 0.664 |
| | Low | 7.489*** | -0.624*** | -0.241*** | 0.333*** | 0.061*** | 0.678 |
| | 2 | 5.780*** | -0.593*** | -0.263*** | 0.077*** | 0.057*** | 0.667 |
| 4 | 3 | 5.736*** | -0.598*** | -0.249*** | -0.022* | 0.067*** | 0.675 |
| | 4 | 5.803*** | -0.586*** | -0.256*** | -0.090*** | 0.031*** | 0.671 |
| | High | 8.178*** | -0.630*** | -0.269*** | -0.225*** | 0.048*** | 0.677 |
| | Low | 2.339* | -0.558*** | 0.136*** | 0.550*** | 0.083*** | 0.703 |
| | 2 | 2.085* | -0.521*** | 0.180*** | 0.241*** | 0.036*** | 0.700 |
| Big | 3 | 2.882** | -0.567*** | 0.111*** | 0.070*** | 0.080*** | 0.698 |
| | 4 | 4.002*** | -0.563*** | 0.200*** | -0.139*** | 0.031*** | 0.681 |
| | High | 5.042*** | -0.621*** | 0.292*** | -0.348*** | 0.105*** | 0.672 |

The results for the Japan Index in Table 10 are not as robust as the Developed Indices, with statistically significant excess returns recorded primarily in the lower half of quintiles when sorted on size. There is clear performance drop off as size increases, with a statistically significant negative excess return for Quintile *B*-2 of -4.224%. Excluding excess returns that are not statistically different from zero, the abnormal returns range from -4.224% to 15.329%

per annum. As is the case with the Developed Indices, excess returns diminish as book-to-market increases for each size category.

**Table 10: Factor Regression Results for Value Weighted Japan Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 15.329*** | -0.598*** | -0.723*** | 0.117*** | 0.070*** | 0.642 |
| | 2 | 10.671*** | -0.520*** | -0.607*** | 0.013 | 0.055*** | 0.641 |
| Small | 3 | 10.105*** | -0.512*** | -0.591*** | -0.020* | -0.002 | 0.647 |
| | 4 | 8.992*** | -0.491*** | -0.547*** | -0.068*** | 0.026*** | 0.657 |
| | High | 8.923*** | -0.471*** | -0.520*** | -0.149*** | 0.030*** | 0.675 |
| | Low | 10.694*** | -0.640*** | -0.630*** | 0.297*** | 0.008 | 0.690 |
| | 2 | 8.923*** | -0.595*** | -0.543*** | 0.100*** | 0.059*** | 0.687 |
| 2 | 3 | 7.021*** | -0.576*** | -0.522*** | -0.054*** | 0.068*** | 0.688 |
| | 4 | 4.890*** | -0.564*** | -0.480*** | -0.074*** | 0.076*** | 0.684 |
| | High | 6.025*** | -0.596*** | -0.507*** | -0.209*** | 0.033*** | 0.712 |
| | Low | 9.812*** | -0.635*** | -0.510*** | 0.288*** | 0.040*** | 0.667 |
| | 2 | 3.679** | -0.614*** | -0.391*** | 0.141*** | 0.050*** | 0.679 |
| 3 | 3 | 3.776** | -0.590*** | -0.383*** | -0.012 | 0.099*** | 0.680 |
| | 4 | 2.182 | -0.584*** | -0.384*** | -0.140*** | 0.067*** | 0.678 |
| | High | 2.519* | -0.596*** | -0.383*** | -0.236*** | 0.030*** | 0.690 |
| | Low | 5.263*** | -0.633*** | -0.287*** | 0.326*** | 0.007 | 0.684 |
| | 2 | -0.778 | -0.584*** | -0.215*** | 0.107*** | 0.067*** | 0.671 |
| 4 | 3 | -1.576 | -0.572*** | -0.189*** | -0.042*** | 0.058*** | 0.671 |
| | 4 | -1.160 | -0.574*** | -0.204*** | -0.144*** | 0.058*** | 0.673 |
| | High | -0.411 | -0.605*** | -0.227*** | -0.260*** | 0.065*** | 0.669 |
| | Low | -2.269 | -0.596*** | 0.103*** | 0.466*** | 0.054*** | 0.717 |
| | 2 | -4.224*** | -0.560*** | 0.080*** | 0.154*** | 0.081*** | 0.694 |
| Big | 3 | -2.367 | -0.583*** | 0.053*** | -0.004 | 0.095*** | 0.695 |
| | 4 | -3.928** | -0.576*** | 0.036*** | -0.164*** | -0.002 | 0.672 |
| | High | -3.305* | -0.632*** | 0.031** | -0.333*** | 0.029*** | 0.635 |

The results for the Asia Pacific excluding Japan Index in Table 11 significantly exceed the excess returns found for the Developed and Japan Indices with statistically significant abnormal returns ranging from 5.909% to 18.361% per annum. All excess returns have a statistically significant result with 99% confidence.

Consistent with the findings for the Developed Indices, performance declines as size increases, although the drop in performance is not as severe. Performance and book-to-market also appears to follow the same reversal relationship discussed above.

**Table 11: Factor Regression Results for Value Weighted Asia Pacific excl. Japan Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 18.361*** | -0.623*** | -0.561*** | 0.172*** | -0.049*** | 0.576 |
| | 2 | 18.082*** | -0.623*** | -0.551*** | 0.131*** | -0.020** | 0.623 |
| Small | 3 | 15.318*** | -0.591*** | -0.511*** | 0.073*** | -0.033*** | 0.621 |
| | 4 | 13.824*** | -0.517*** | -0.456*** | 0.026*** | -0.022*** | 0.625 |
| | High | 14.616*** | -0.472*** | -0.431*** | -0.107*** | -0.037*** | 0.630 |
| | Low | 16.913*** | -0.655*** | -0.552*** | 0.185*** | -0.023*** | 0.639 |
| | 2 | 16.004*** | -0.664*** | -0.550*** | 0.126*** | 0.031*** | 0.637 |
| 2 | 3 | 14.201*** | -0.615*** | -0.504*** | 0.065*** | -0.014* | 0.644 |
| | 4 | 15.414*** | -0.620*** | -0.476*** | -0.048*** | -0.051*** | 0.657 |
| | High | 16.215*** | -0.597*** | -0.496*** | -0.228*** | -0.033*** | 0.630 |
| | Low | 14.750*** | -0.694*** | -0.474*** | 0.249*** | -0.016* | 0.625 |
| | 2 | 12.057*** | -0.634*** | -0.435*** | 0.136*** | -0.020** | 0.619 |
| 3 | 3 | 11.029*** | -0.615*** | -0.358*** | 0.099*** | -0.015* | 0.616 |
| | 4 | 12.262*** | -0.577*** | -0.383*** | -0.029*** | 0.022*** | 0.601 |
| | High | 15.152*** | -0.600*** | -0.374*** | -0.201*** | 0.016* | 0.602 |
| | Low | 8.898*** | -0.622*** | -0.301*** | 0.167*** | 0.000 | 0.608 |
| | 2 | 7.853*** | -0.551*** | -0.212*** | 0.161*** | -0.005 | 0.595 |
| 4 | 3 | 8.274*** | -0.585*** | -0.177*** | 0.165*** | -0.019** | 0.513 |
| | 4 | 8.414*** | -0.579*** | -0.225*** | 0.049*** | 0.013* | 0.609 |
| | High | 13.969*** | -0.615*** | -0.205*** | -0.168*** | -0.002 | 0.596 |
| | Low | 6.915*** | -0.644*** | 0.086*** | 0.376*** | -0.042*** | 0.672 |
| | 2 | 5.909*** | -0.585*** | 0.070*** | 0.234*** | -0.011 | 0.676 |
| Big | 3 | 6.403*** | -0.633*** | 0.001 | 0.080*** | 0.038*** | 0.664 |
| | 4 | 9.058*** | -0.582*** | 0.053*** | -0.142*** | 0.000 | 0.644 |
| | High | 12.250*** | -0.653*** | 0.094*** | -0.330*** | 0.035*** | 0.620 |

The results for the Europe Index in Table 12 are more in line with the performance of the Japan Index, with abnormal returns ranging from -2.452% to 12.614%. However, the performance decrease as size increases is not as large with statistically significant positive

results occurring until Quintile *4-High*. As previously seen above, performance declines as size increases. The performance and book-to-market relationship is consistent for smaller quintiles. However, as size increases it not as clear, with what seems to be a slight increase in performance as book-to-market increases for quintile size category *3*, *4* and *Big*.

**Table 12: Factor Regression Results for Value Weighted Europe Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 12.614*** | -0.561*** | -0.537*** | 0.235*** | 0.046*** | 0.646 |
| | 2 | 9.966*** | -0.520*** | -0.493*** | 0.184*** | 0.046*** | 0.649 |
| Small | 3 | 8.415*** | -0.487*** | -0.462*** | 0.100*** | 0.032*** | 0.642 |
| | 4 | 8.088*** | -0.463*** | -0.444*** | 0.008 | 0.027*** | 0.640 |
| | High | 7.606*** | -0.432*** | -0.416*** | -0.082*** | 0.007 | 0.637 |
| | Low | 9.765*** | -0.611*** | -0.495*** | 0.328*** | 0.072*** | 0.669 |
| | 2 | 7.696*** | -0.569*** | -0.477*** | 0.144*** | 0.076*** | 0.666 |
| 2 | 3 | 7.525*** | -0.544*** | -0.446*** | 0.014 | 0.049*** | 0.665 |
| | 4 | 7.225*** | -0.530*** | -0.433*** | -0.072*** | 0.041*** | 0.651 |
| | High | 7.744*** | -0.534*** | -0.423*** | -0.179*** | 0.034*** | 0.666 |
| | Low | 6.918*** | -0.646*** | -0.398*** | 0.354*** | 0.090*** | 0.654 |
| | 2 | 6.383*** | -0.613*** | -0.402*** | 0.112*** | 0.062*** | 0.650 |
| 3 | 3 | 5.836*** | -0.581*** | -0.382*** | -0.029** | 0.064*** | 0.655 |
| | 4 | 6.066*** | -0.583*** | -0.381*** | -0.097*** | 0.046*** | 0.659 |
| | High | 7.667*** | -0.586*** | -0.356*** | -0.226*** | 0.052*** | 0.668 |
| | Low | 3.003** | -0.622*** | -0.226*** | 0.383*** | 0.108*** | 0.661 |
| | 2 | 2.838** | -0.593*** | -0.233*** | 0.097*** | 0.077*** | 0.659 |
| 4 | 3 | 3.287*** | -0.585*** | -0.214*** | -0.023* | 0.074*** | 0.670 |
| | 4 | 4.718*** | -0.598*** | -0.224*** | -0.095*** | 0.091*** | 0.670 |
| | High | 6.829*** | -0.643*** | -0.224*** | -0.288*** | 0.091*** | 0.682 |
| | Low | -2.452* | -0.519*** | 0.202*** | 0.584*** | 0.122*** | 0.702 |
| | 2 | -1.084 | -0.507*** | 0.188*** | 0.234*** | 0.036*** | 0.702 |
| Big | 3 | 0.388 | -0.561*** | 0.161*** | 0.099*** | 0.086*** | 0.709 |
| | 4 | 0.405 | -0.580*** | 0.186*** | -0.164*** | 0.049*** | 0.689 |
| | High | 3.135* | -0.650*** | 0.164*** | -0.320*** | 0.191*** | 0.707 |

The results for the North America Index in Table 13 are similar to Japan and Europe with significant performance drop off for bigger quintiles. Abnormal returns range from 2.212% to

14.448%, with no statistically significant negative alphas present. The performance decrease as size increases is much steeper than the Europe Index. Consistent to the above findings, the performance and book-to-market relationship is consistent for smaller quintiles, with a reversal occurring for quintile size category *3*, *4* and *Big*.

**Table 13: Factor Regression Results for Value Weighted North America Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 14.448*** | -0.652*** | -0.619*** | 0.148*** | 0.037*** | 0.679 |
| | 2 | 10.362*** | -0.614*** | -0.522*** | 0.042*** | 0.021*** | 0.686 |
| Small | 3 | 7.230*** | -0.563*** | -0.461*** | -0.062*** | 0.015** | 0.683 |
| | 4 | 5.944*** | -0.528*** | -0.433*** | -0.177*** | -0.004 | 0.696 |
| | High | 6.445*** | -0.505*** | -0.395*** | -0.301*** | 0.000 | 0.685 |
| | Low | 8.307*** | -0.693*** | -0.565*** | 0.409*** | 0.082*** | 0.713 |
| | 2 | 5.690*** | -0.648*** | -0.482*** | 0.184*** | 0.044*** | 0.711 |
| 2 | 3 | 2.212* | -0.600*** | -0.402*** | -0.040*** | 0.047*** | 0.700 |
| | 4 | 2.043 | -0.596*** | -0.368*** | -0.213*** | 0.035*** | 0.707 |
| | High | 3.751*** | -0.610*** | -0.390*** | -0.372*** | 0.032*** | 0.711 |
| | Low | 5.607*** | -0.682*** | -0.418*** | 0.369*** | 0.051*** | 0.694 |
| | 2 | 4.454*** | -0.642*** | -0.329*** | 0.154*** | 0.051*** | 0.702 |
| 3 | 3 | 2.870** | -0.581*** | -0.276*** | -0.050*** | 0.031*** | 0.692 |
| | 4 | 3.463*** | -0.578*** | -0.223*** | -0.235*** | 0.021*** | 0.700 |
| | High | 4.053*** | -0.594*** | -0.237*** | -0.346*** | 0.016** | 0.697 |
| | Low | 3.304** | -0.678*** | -0.219*** | 0.463*** | 0.094*** | 0.674 |
| | 2 | 2.141 | -0.608*** | -0.117*** | 0.132*** | 0.050*** | 0.691 |
| 4 | 3 | 2.337* | -0.571*** | -0.103*** | -0.099*** | 0.002 | 0.678 |
| | 4 | 3.952*** | -0.575*** | -0.066*** | -0.231*** | 0.020*** | 0.674 |
| | High | 4.324*** | -0.608*** | -0.110*** | -0.370*** | 0.045*** | 0.701 |
| | Low | -1.647 | -0.558*** | 0.159*** | 0.355*** | 0.080*** | 0.708 |
| | 2 | -0.643 | -0.557*** | 0.153*** | 0.085*** | 0.030*** | 0.708 |
| Big | 3 | 0.470 | -0.598*** | 0.111*** | -0.091*** | 0.042*** | 0.708 |
| | 4 | 1.294 | -0.590*** | 0.116*** | -0.219*** | 0.038*** | 0.702 |
| | High | 2.932* | -0.747*** | 0.047*** | -0.406*** | 0.100*** | 0.703 |

It is clear from the regression results the MA significantly outperforms the BH for the lowest size quintiles irrespective of country. However, different markets appear to return

inconsistent results as size increases. Additionally, for small size quintiles, book-to-market has a negative relationship with performance. The negative relationship diminishes as size increases and appears to reverse becoming a small positive relationship for the bigger size quintiles. However, for each of the larger size categories, the increase in performance is not consistent, with what appears to be a performance non-symmetrical smile occurring, with the lowest and highest book-to-market quintiles having the highest performance.

### 2.3.3 Market Timing

Regression analysis was performed using model (4) and (5) from Section 1.6 to determine if market timing played a role in the MA outperforming the BH as per the previous section. The results can be seen in Table 14 to 19.

The results for the Developed including and excluding US Indices show a positive statistically significant result for $\beta_{i,m^2}$ and $\gamma_{i,m}$ in all but the biggest quintile portfolios. This represents evidence in favour of market timing ability for the MA over the BH.

The results for the Japan Index however show limited results in favour of market timing ability for the MA over the BH. Conversely, the results for the Asia Pacific excluding Japan Index show the most robust result with positive statistically significant results for $\beta_{i,m^2}$ and $\gamma_{i,m}$ in all quintile portfolios using model (4) and (5). This represents the strongest evidence in favour of market timing ability for the MA over the BH in the Asia Pacific market. It also corroborates the results from Section 2.3.2 which found the highest excess return performance, with an alpha of 18.361% per annum.

The results for the Europe and North America Indices show a positive statistically significant result for $\beta_{i,m^2}$ and $\gamma_{i,m}$ in only the smallest quintile portfolios with inconsistent results thereafter.

**Table 14: Market Timing Results for Value Weighted Developed Index**

Value Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 12.074*** | -0.453*** | 0.017*** | 0.475 | 3.066 | -0.370*** | 0.163*** | 0.478 |
| | 2 | 9.452*** | -0.419*** | 0.015*** | 0.505 | 1.854 | -0.348*** | 0.140*** | 0.507 |
| Small | 3 | 7.178*** | -0.392*** | 0.014*** | 0.517 | 0.416 | -0.328*** | 0.127*** | 0.518 |
| | 4 | 5.622*** | -0.358*** | 0.015*** | 0.521 | -0.790 | -0.295*** | 0.125*** | 0.522 |
| | High | 4.209*** | -0.295*** | 0.014*** | 0.446 | -1.044 | -0.242*** | 0.107*** | 0.445 |
| | Low | 11.065*** | -0.550*** | 0.011*** | 0.580 | 5.210*** | -0.496*** | 0.107*** | 0.581 |
| | 2 | 8.022*** | -0.508*** | 0.012*** | 0.609 | 2.768* | -0.457*** | 0.101*** | 0.609 |
| 2 | 3 | 6.357*** | -0.472*** | 0.009*** | 0.618 | 2.333 | -0.434*** | 0.076*** | 0.618 |
| | 4 | 5.181*** | -0.455*** | 0.008*** | 0.607 | 1.580 | -0.421*** | 0.067*** | 0.607 |
| | High | 4.942*** | -0.431*** | 0.010*** | 0.568 | 1.415 | -0.394*** | 0.073*** | 0.567 |
| | Low | 10.248*** | -0.597*** | 0.005** | 0.610 | 7.298*** | -0.571*** | 0.053*** | 0.610 |
| | 2 | 7.794*** | -0.567*** | 0.008*** | 0.644 | 4.294*** | -0.532*** | 0.068*** | 0.644 |
| 3 | 3 | 5.853*** | -0.529*** | 0.007*** | 0.657 | 2.415* | -0.497*** | 0.063*** | 0.658 |
| | 4 | 5.602*** | -0.508*** | 0.005*** | 0.647 | 3.002** | -0.483*** | 0.049*** | 0.647 |
| | High | 4.904*** | -0.496*** | 0.008*** | 0.621 | 1.726 | -0.464*** | 0.063*** | 0.621 |
| | Low | 8.965*** | -0.622*** | 0.002 | 0.627 | 6.521*** | -0.602*** | 0.039** | 0.627 |
| | 2 | 6.258*** | -0.562*** | 0.003 | 0.671 | 3.866*** | -0.541*** | 0.039*** | 0.671 |
| 4 | 3 | 6.396*** | -0.558*** | 0.003* | 0.682 | 3.225** | -0.532*** | 0.051*** | 0.682 |
| | 4 | 5.755*** | -0.523*** | 0.002 | 0.648 | 3.600** | -0.506*** | 0.033** | 0.648 |
| | High | 6.111*** | -0.563*** | 0.003* | 0.645 | 3.312** | -0.539*** | 0.046*** | 0.646 |
| | Low | 5.769*** | -0.604*** | -0.007*** | 0.623 | 4.996*** | -0.607*** | -0.009 | 0.623 |
| | 2 | 5.566*** | -0.588*** | -0.005*** | 0.690 | 3.725*** | -0.581*** | 0.012 | 0.690 |
| Big | 3 | 5.354*** | -0.613*** | -0.003* | 0.701 | 3.964*** | -0.607*** | 0.010 | 0.701 |
| | 4 | 7.055*** | -0.635*** | -0.012*** | 0.680 | 6.313*** | -0.643*** | -0.020 | 0.678 |
| | High | 7.078*** | -0.741*** | -0.003 | 0.653 | 5.333*** | -0.732*** | 0.016 | 0.653 |

**Table 15: Market Timing Results for Value Weighted Developed excluding US. Index**

Value Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 9.711*** | -0.398*** | 0.020*** | 0.467 | 0.985 | -0.320*** | 0.158*** | 0.467 |
| | 2 | 7.170*** | -0.363*** | 0.020*** | 0.481 | -1.146 | -0.287*** | 0.153*** | 0.480 |
| Small | 3 | 5.123*** | -0.343*** | 0.019*** | 0.486 | -1.991 | -0.277*** | 0.134*** | 0.485 |
| | 4 | 4.224*** | -0.319*** | 0.017*** | 0.480 | -2.119 | -0.259*** | 0.120*** | 0.478 |
| | High | 3.126*** | -0.275*** | 0.014*** | 0.404 | -1.651 | -0.228*** | 0.095*** | 0.402 |
| | Low | 10.044*** | -0.462*** | 0.014*** | 0.530 | 3.326* | -0.404*** | 0.117*** | 0.530 |
| | 2 | 6.492*** | -0.430*** | 0.017*** | 0.547 | -0.367 | -0.367*** | 0.126*** | 0.547 |
| 2 | 3 | 4.996*** | -0.406*** | 0.014*** | 0.548 | -0.306 | -0.357*** | 0.100*** | 0.547 |
| | 4 | 3.992*** | -0.383*** | 0.013*** | 0.534 | -0.621 | -0.338*** | 0.090*** | 0.533 |
| | High | 3.978*** | -0.379*** | 0.012*** | 0.485 | 0.786 | -0.345*** | 0.069*** | 0.483 |
| | Low | 8.372*** | -0.510*** | 0.011*** | 0.579 | 2.804 | -0.462*** | 0.096*** | 0.579 |
| | 2 | 5.179*** | -0.485*** | 0.015*** | 0.609 | -0.737 | -0.430*** | 0.111*** | 0.608 |
| 3 | 3 | 5.360*** | -0.472*** | 0.008*** | 0.596 | 1.501 | -0.439*** | 0.066*** | 0.596 |
| | 4 | 3.895*** | -0.448*** | 0.009*** | 0.575 | 0.782 | -0.417*** | 0.062*** | 0.574 |
| | High | 4.375*** | -0.452*** | 0.010*** | 0.583 | 1.066 | -0.419*** | 0.066*** | 0.582 |
| | Low | 7.439*** | -0.554*** | 0.007*** | 0.628 | 3.128* | -0.519*** | 0.071*** | 0.629 |
| | 2 | 4.309*** | -0.510*** | 0.008*** | 0.637 | 0.462 | -0.476*** | 0.067*** | 0.637 |
| 4 | 3 | 4.534*** | -0.519*** | 0.005*** | 0.649 | 1.346 | -0.493*** | 0.052*** | 0.650 |
| | 4 | 3.972*** | -0.499*** | 0.005*** | 0.642 | 1.023 | -0.474*** | 0.050*** | 0.643 |
| | High | 5.964*** | -0.538*** | 0.005*** | 0.640 | 2.862* | -0.513*** | 0.050*** | 0.640 |
| | Low | 6.681*** | -0.627*** | -0.004** | 0.642 | 4.968** | -0.622*** | 0.009 | 0.642 |
| | 2 | 4.302*** | -0.593*** | -0.002 | 0.678 | 1.815 | -0.581*** | 0.023* | 0.678 |
| Big | 3 | 4.453*** | -0.618*** | -0.002 | 0.689 | 1.428 | -0.602*** | 0.030** | 0.689 |
| | 4 | 3.807*** | -0.633*** | 0.000 | 0.661 | 1.167 | -0.616*** | 0.032** | 0.662 |
| | High | 5.935*** | -0.730*** | -0.005** | 0.620 | 3.631 | -0.722*** | 0.012 | 0.620 |

**Table 16: Market Timing Results for Value Weighted Japan Index**

Value Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 15.047*** | -0.461*** | 0.001 | 0.430 | 9.511*** | -0.436*** | 0.050** | 0.431 |
| | 2 | 10.318*** | -0.400*** | 0.001 | 0.447 | 5.349* | -0.379*** | 0.042** | 0.448 |
| Small | 3 | 8.305*** | -0.390*** | 0.003** | 0.452 | 3.648 | -0.365*** | 0.051*** | 0.453 |
| | 4 | 9.154*** | -0.377*** | -0.001 | 0.475 | 5.332** | -0.364*** | 0.026* | 0.475 |
| | High | 9.849*** | -0.357*** | -0.004*** | 0.488 | 8.190*** | -0.358*** | 0.000 | 0.488 |
| | Low | 11.088*** | -0.529*** | 0.001 | 0.507 | 4.727 | -0.500*** | 0.057*** | 0.508 |
| | 2 | 9.165*** | -0.494*** | 0.000 | 0.552 | 4.670* | -0.476*** | 0.037** | 0.553 |
| 2 | 3 | 8.699*** | -0.470*** | -0.004*** | 0.562 | 7.663*** | -0.475*** | -0.008 | 0.562 |
| | 4 | 6.452*** | -0.466*** | -0.004*** | 0.574 | 5.960** | -0.473*** | -0.012 | 0.573 |
| | High | 7.329*** | -0.482*** | -0.005*** | 0.591 | 7.797*** | -0.494*** | -0.022 | 0.591 |
| | Low | 9.597*** | -0.551*** | 0.003 | 0.543 | 4.533 | -0.525*** | 0.051*** | 0.543 |
| | 2 | 4.576** | -0.546*** | -0.001 | 0.609 | 3.019 | -0.541*** | 0.009 | 0.609 |
| 3 | 3 | 6.125*** | -0.517*** | -0.005*** | 0.616 | 6.863*** | -0.531*** | -0.026* | 0.615 |
| | 4 | 3.631** | -0.501*** | -0.005*** | 0.610 | 5.227** | -0.517*** | -0.030** | 0.610 |
| | High | 3.324* | -0.505*** | -0.004*** | 0.617 | 4.629* | -0.518*** | -0.026* | 0.617 |
| | Low | 8.639*** | -0.593*** | -0.005*** | 0.620 | 6.528** | -0.594*** | 0.000 | 0.619 |
| | 2 | 1.475 | -0.551*** | -0.004*** | 0.646 | 2.984 | -0.565*** | -0.028** | 0.646 |
| 4 | 3 | -1.273 | -0.535*** | -0.001 | 0.655 | 0.772 | -0.545*** | -0.021 | 0.655 |
| | 4 | 0.608 | -0.527*** | -0.005*** | 0.650 | 3.021 | -0.547*** | -0.039*** | 0.650 |
| | High | 2.179 | -0.546*** | -0.008*** | 0.633 | 5.856** | -0.577*** | -0.060*** | 0.632 |
| | Low | 3.956** | -0.646*** | -0.009*** | 0.673 | 7.392*** | -0.679*** | -0.063*** | 0.671 |
| | 2 | -0.353 | -0.590*** | -0.007*** | 0.685 | 2.849 | -0.617*** | -0.052*** | 0.684 |
| Big | 3 | 1.272 | -0.599*** | -0.008*** | 0.689 | 3.359 | -0.623*** | -0.047*** | 0.688 |
| | 4 | -1.707 | -0.573*** | -0.006*** | 0.664 | 2.160 | -0.601*** | -0.055*** | 0.663 |
| | High | 0.426 | -0.619*** | -0.011*** | 0.608 | 4.341 | -0.657*** | -0.073*** | 0.607 |

**Table 17: Market Timing Results for Value Weighted Asia Pacific excluding Japan Index**

Value Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 10.853*** | -0.455*** | 0.033*** | 0.433 | -4.825* | -0.320*** | 0.276*** | 0.427 |
| | 2 | 9.884*** | -0.454*** | 0.035*** | 0.492 | -6.337*** | -0.314*** | 0.290*** | 0.483 |
| Small | 3 | 7.305*** | -0.431*** | 0.032*** | 0.499 | -8.202*** | -0.298*** | 0.273*** | 0.492 |
| | 4 | 5.763*** | -0.371*** | 0.031*** | 0.510 | -9.899*** | -0.238*** | 0.271*** | 0.503 |
| | High | 6.317*** | -0.325*** | 0.028*** | 0.498 | -7.179*** | -0.210*** | 0.236*** | 0.489 |
| | Low | 10.107*** | -0.490*** | 0.031*** | 0.500 | -5.881** | -0.356*** | 0.276*** | 0.496 |
| | 2 | 8.518*** | -0.496*** | 0.034*** | 0.524 | -7.000*** | -0.361*** | 0.279*** | 0.516 |
| 2 | 3 | 6.404*** | -0.457*** | 0.032*** | 0.535 | -9.022*** | -0.325*** | 0.271*** | 0.529 |
| | 4 | 6.923*** | -0.463*** | 0.030*** | 0.559 | -9.001*** | -0.331*** | 0.270*** | 0.556 |
| | High | 5.894*** | -0.421*** | 0.032*** | 0.511 | -10.482*** | -0.284*** | 0.282*** | 0.506 |
| | Low | 9.172*** | -0.558*** | 0.029*** | 0.522 | -5.661** | -0.434*** | 0.254*** | 0.519 |
| | 2 | 5.353*** | -0.503*** | 0.029*** | 0.538 | -7.229*** | -0.391*** | 0.231*** | 0.531 |
| 3 | 3 | 5.739*** | -0.507*** | 0.023*** | 0.560 | -6.375*** | -0.406*** | 0.206*** | 0.558 |
| | 4 | 4.852*** | -0.451*** | 0.028*** | 0.552 | -7.622*** | -0.340*** | 0.228*** | 0.544 |
| | High | 6.040*** | -0.464*** | 0.030*** | 0.550 | -8.682*** | -0.340*** | 0.256*** | 0.545 |
| | Low | 3.472** | -0.535*** | 0.026*** | 0.566 | -9.298*** | -0.427*** | 0.222*** | 0.563 |
| | 2 | 3.372** | -0.491*** | 0.021*** | 0.564 | -7.259*** | -0.401*** | 0.185*** | 0.562 |
| 4 | 3 | 11.603*** | -0.546*** | -0.007*** | 0.486 | 4.987** | -0.516*** | 0.051*** | 0.486 |
| | 4 | 3.117** | -0.508*** | 0.022*** | 0.595 | -7.158*** | -0.419*** | 0.183*** | 0.592 |
| | High | 6.803*** | -0.534*** | 0.022*** | 0.582 | -4.905** | -0.437*** | 0.199*** | 0.580 |
| | Low | 7.012*** | -0.693*** | 0.008*** | 0.626 | -0.053 | -0.641*** | 0.103*** | 0.627 |
| | 2 | 5.243*** | -0.619*** | 0.008*** | 0.654 | -1.080 | -0.572*** | 0.095*** | 0.655 |
| Big | 3 | 5.388*** | -0.637*** | 0.007*** | 0.662 | 0.907 | -0.602*** | 0.073*** | 0.662 |
| | 4 | 6.639*** | -0.587*** | 0.005*** | 0.633 | 2.194 | -0.555*** | 0.064*** | 0.633 |
| | High | 8.742*** | -0.658*** | 0.004** | 0.575 | 3.136 | -0.619*** | 0.076*** | 0.576 |

**Table 18: Market Timing Results for Value Weighted Europe Index**

Value Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 11.105*** | -0.370*** | 0.006*** | 0.470 | 3.978** | -0.322*** | 0.094*** | 0.472 |
| | 2 | 7.971*** | -0.347*** | 0.008*** | 0.484 | 1.166 | -0.299*** | 0.095*** | 0.486 |
| Small | 3 | 6.245*** | -0.327*** | 0.007*** | 0.487 | -0.290 | -0.281*** | 0.090*** | 0.489 |
| | 4 | 5.566*** | -0.312*** | 0.007*** | 0.489 | -0.740 | -0.267*** | 0.088*** | 0.491 |
| | High | 4.668*** | -0.293*** | 0.007*** | 0.482 | -1.125 | -0.251*** | 0.082*** | 0.484 |
| | Low | 10.684*** | -0.436*** | 0.001 | 0.526 | 5.675*** | -0.408*** | 0.054*** | 0.527 |
| | 2 | 7.143*** | -0.410*** | 0.004*** | 0.545 | 2.526 | -0.379*** | 0.060*** | 0.546 |
| 2 | 3 | 6.802*** | -0.397*** | 0.002* | 0.556 | 1.942 | -0.368*** | 0.057*** | 0.557 |
| | 4 | 5.614*** | -0.390*** | 0.004*** | 0.544 | 0.485 | -0.357*** | 0.065*** | 0.545 |
| | High | 5.263*** | -0.401*** | 0.005*** | 0.554 | 0.216 | -0.366*** | 0.069*** | 0.555 |
| | Low | 8.453*** | -0.507*** | 0.000 | 0.565 | 5.362** | -0.490*** | 0.032** | 0.565 |
| | 2 | 6.471*** | -0.479*** | 0.001 | 0.583 | 2.972 | -0.459*** | 0.040*** | 0.583 |
| 3 | 3 | 6.355*** | -0.462*** | -0.001 | 0.591 | 4.415** | -0.454*** | 0.015 | 0.591 |
| | 4 | 6.000*** | -0.464*** | -0.001 | 0.592 | 3.579** | -0.453*** | 0.022* | 0.592 |
| | High | 6.467*** | -0.483*** | 0.002 | 0.596 | 2.860 | -0.461*** | 0.042*** | 0.597 |
| | Low | 7.082*** | -0.545*** | -0.006*** | 0.606 | 6.954*** | -0.553*** | -0.019 | 0.605 |
| | 2 | 4.648*** | -0.521*** | -0.003** | 0.636 | 3.463* | -0.520*** | 0.002 | 0.636 |
| 4 | 3 | 5.771*** | -0.526*** | -0.006*** | 0.652 | 5.198*** | -0.533*** | -0.015 | 0.651 |
| | 4 | 7.154*** | -0.543*** | -0.007*** | 0.646 | 6.641*** | -0.550*** | -0.016 | 0.645 |
| | High | 7.288*** | -0.596*** | -0.002 | 0.639 | 4.282** | -0.584*** | 0.023 | 0.639 |
| | Low | 5.403*** | -0.583*** | -0.014*** | 0.607 | 7.661*** | -0.617*** | -0.067*** | 0.604 |
| | 2 | 3.832*** | -0.568*** | -0.011*** | 0.676 | 5.151*** | -0.592*** | -0.049*** | 0.674 |
| Big | 3 | 5.533*** | -0.628*** | -0.012*** | 0.697 | 6.130*** | -0.650*** | -0.044*** | 0.694 |
| | 4 | 5.026*** | -0.663*** | -0.014*** | 0.674 | 7.574*** | -0.698*** | -0.071*** | 0.672 |
| | High | 8.496*** | -0.758*** | -0.013*** | 0.661 | 8.985*** | -0.782*** | -0.048*** | 0.659 |

**Table 19: Market Timing Results for Value Weighted North America Index**

Value Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 11.105*** | -0.370*** | 0.006*** | 0.470 | 3.978** | -0.322*** | 0.094*** | 0.472 |
| | 2 | 7.971*** | -0.347*** | 0.008*** | 0.484 | 1.166 | -0.299*** | 0.095*** | 0.486 |
| Small | 3 | 6.245*** | -0.327*** | 0.007*** | 0.487 | -0.290 | -0.281*** | 0.090*** | 0.489 |
| | 4 | 5.566*** | -0.312*** | 0.007*** | 0.489 | -0.740 | -0.267*** | 0.088*** | 0.491 |
| | High | 4.668*** | -0.293*** | 0.007*** | 0.482 | -1.125 | -0.251*** | 0.082*** | 0.484 |
| | Low | 10.684*** | -0.436*** | 0.001 | 0.526 | 5.675*** | -0.408*** | 0.054*** | 0.527 |
| | 2 | 7.143*** | -0.410*** | 0.004*** | 0.545 | 2.526 | -0.379*** | 0.060*** | 0.546 |
| 2 | 3 | 6.802*** | -0.397*** | 0.002* | 0.556 | 1.942 | -0.368*** | 0.057*** | 0.557 |
| | 4 | 5.614*** | -0.390*** | 0.004*** | 0.544 | 0.485 | -0.357*** | 0.065*** | 0.545 |
| | High | 5.263*** | -0.401*** | 0.005*** | 0.554 | 0.216 | -0.366*** | 0.069*** | 0.555 |
| | Low | 8.453*** | -0.507*** | 0.000 | 0.565 | 5.362** | -0.490*** | 0.032** | 0.565 |
| | 2 | 6.471*** | -0.479*** | 0.001 | 0.583 | 2.972 | -0.459*** | 0.040*** | 0.583 |
| 3 | 3 | 6.355*** | -0.462*** | -0.001 | 0.591 | 4.415** | -0.454*** | 0.015 | 0.591 |
| | 4 | 6.000*** | -0.464*** | -0.001 | 0.592 | 3.579** | -0.453*** | 0.022* | 0.592 |
| | High | 6.467*** | -0.483*** | 0.002 | 0.596 | 2.860 | -0.461*** | 0.042*** | 0.597 |
| | Low | 7.082*** | -0.545*** | -0.006*** | 0.606 | 6.954*** | -0.553*** | -0.019 | 0.605 |
| | 2 | 4.648*** | -0.521*** | -0.003** | 0.636 | 3.463* | -0.520*** | 0.002 | 0.636 |
| 4 | 3 | 5.771*** | -0.526*** | -0.006*** | 0.652 | 5.198*** | -0.533*** | -0.015 | 0.651 |
| | 4 | 7.154*** | -0.543*** | -0.007*** | 0.646 | 6.641*** | -0.550*** | -0.016 | 0.645 |
| | High | 7.288*** | -0.596*** | -0.002 | 0.639 | 4.282** | -0.584*** | 0.023 | 0.639 |
| | Low | 5.403*** | -0.583*** | -0.014*** | 0.607 | 7.661*** | -0.617*** | -0.067*** | 0.604 |
| | 2 | 3.832*** | -0.568*** | -0.011*** | 0.676 | 5.151*** | -0.592*** | -0.049*** | 0.674 |
| Big | 3 | 5.533*** | -0.628*** | -0.012*** | 0.697 | 6.130*** | -0.650*** | -0.044*** | 0.694 |
| | 4 | 5.026*** | -0.663*** | -0.014*** | 0.674 | 7.574*** | -0.698*** | -0.071*** | 0.672 |
| | High | 8.496*** | -0.758*** | -0.013*** | 0.661 | 8.985*** | -0.782*** | -0.048*** | 0.659 |

### 2.3.4 Trading Statistics

The following section reports via Table 20 to 25 the value weighted trading statistics for the TIS portfolio. This follows from the methodology used in Glabadanidis (2017).

Each table contains the following variables: $\Delta\mu$ is the MA change in mean return, $\Delta\sigma$ is the MA improved change in standard deviation, *pA* is the proportion of days not trading, *NT* is the number of trades, *BETC* is the break-even transaction costs, *p1* is the proportion of days a buy signal is followed by a positive return of the underlying, *p2* is the proportion of days a buy signal is followed by a positive return in excess of the risk-free rate, *NT/6* and *BETC*6* is the adjusted number of trades and break-even transaction costs given the results are based on a CMA of 6 equal weighted moving average strategies.

When reviewing index specific results, the Developed Index in Table 20 can be seen to provide considerable risk reduction across all quintiles. The MA signal occurs less than half the time, with total days not trading of 57% or higher. Additionally, when buying into the portfolio, a positive return occurs at a minimum 56% corresponding to a correct choice where the return is above the risk-free rate (the alternative) a minimum 53% of the time. The adjusted *BETC*6* is between 5 and 89 basis points and is negatively related to size.

**Table 20: Summary Trading Statistics for Value Weighted Developed Index**

Value Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 12.65 | 6.00 | 0.57 | 2482 | 0.15 | 0.62 | 0.54 | 414 | 0.89 |
| | 2 | 9.88 | 5.29 | 0.60 | 2467 | 0.12 | 0.61 | 0.55 | 411 | 0.70 |
| Small | 3 | 7.66 | 4.80 | 0.63 | 2474 | 0.09 | 0.61 | 0.56 | 412 | 0.54 |
| | 4 | 6.49 | 4.35 | 0.64 | 2461 | 0.08 | 0.60 | 0.56 | 410 | 0.46 |
| | High | 5.24 | 3.80 | 0.67 | 2397 | 0.06 | 0.61 | 0.58 | 400 | 0.38 |
| | Low | 10.00 | 6.59 | 0.58 | 2699 | 0.11 | 0.61 | 0.54 | 450 | 0.65 |
| | 2 | 7.38 | 5.84 | 0.61 | 2681 | 0.08 | 0.60 | 0.54 | 447 | 0.48 |
| 2 | 3 | 5.25 | 5.25 | 0.63 | 2696 | 0.06 | 0.60 | 0.55 | 449 | 0.34 |
| | 4 | 3.98 | 5.12 | 0.64 | 2720 | 0.04 | 0.59 | 0.55 | 453 | 0.25 |
| | High | 4.37 | 5.00 | 0.63 | 2735 | 0.05 | 0.58 | 0.54 | 456 | 0.28 |
| | Low | 7.77 | 6.95 | 0.60 | 2798 | 0.08 | 0.60 | 0.54 | 466 | 0.48 |
| | 2 | 6.08 | 6.35 | 0.61 | 2774 | 0.06 | 0.60 | 0.54 | 462 | 0.38 |
| 3 | 3 | 4.09 | 5.79 | 0.63 | 2818 | 0.04 | 0.59 | 0.54 | 470 | 0.25 |
| | 4 | 3.70 | 5.56 | 0.62 | 2807 | 0.04 | 0.59 | 0.54 | 468 | 0.23 |
| | High | 3.57 | 5.54 | 0.63 | 2843 | 0.04 | 0.58 | 0.54 | 474 | 0.22 |
| | Low | 5.79 | 7.17 | 0.61 | 2835 | 0.06 | 0.60 | 0.54 | 472 | 0.36 |
| | 2 | 3.56 | 6.09 | 0.63 | 2784 | 0.04 | 0.59 | 0.54 | 464 | 0.22 |
| 4 | 3 | 3.77 | 6.04 | 0.62 | 2872 | 0.04 | 0.59 | 0.54 | 479 | 0.23 |
| | 4 | 3.04 | 5.75 | 0.64 | 2821 | 0.03 | 0.58 | 0.54 | 470 | 0.19 |
| | High | 3.51 | 6.22 | 0.63 | 2796 | 0.04 | 0.58 | 0.54 | 466 | 0.22 |
| | Low | 0.85 | 6.94 | 0.64 | 2974 | 0.01 | 0.58 | 0.54 | 496 | 0.05 |
| | 2 | 1.19 | 6.38 | 0.63 | 2922 | 0.01 | 0.58 | 0.53 | 487 | 0.07 |
| Big | 3 | 1.16 | 6.65 | 0.64 | 2984 | 0.01 | 0.57 | 0.54 | 497 | 0.07 |
| | 4 | 1.17 | 6.99 | 0.63 | 2976 | 0.01 | 0.57 | 0.53 | 496 | 0.07 |
| | High | 2.23 | 8.50 | 0.62 | 2873 | 0.02 | 0.56 | 0.53 | 479 | 0.13 |

The Developed excluding US Index in Table 21 also provides considerable risk reduction across all quintiles. The results are similar to the previous index with total days not trading of 56% or higher. After buying into the portfolio a positive return occurs at a minimum 56% and the return is above the risk-free rate a minimum 52% of the time. The adjusted *BETC*6* is between 7 and 87 basis points.

**Table 21: Summary Trading Statistics for Value Weighted Developed excl. US Index**

Value Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 12.66 | 5.78 | 0.56 | 2535 | 0.15 | 0.61 | 0.53 | 422 | 0.87 |
| | 2 | 10.31 | 5.10 | 0.59 | 2573 | 0.12 | 0.60 | 0.54 | 429 | 0.70 |
| Small | 3 | 7.92 | 4.72 | 0.61 | 2630 | 0.09 | 0.60 | 0.55 | 438 | 0.53 |
| | 4 | 6.72 | 4.35 | 0.62 | 2672 | 0.07 | 0.60 | 0.55 | 445 | 0.44 |
| | High | 5.27 | 4.01 | 0.63 | 2624 | 0.06 | 0.61 | 0.56 | 437 | 0.35 |
| | Low | 11.25 | 6.33 | 0.55 | 2706 | 0.12 | 0.61 | 0.53 | 451 | 0.72 |
| | 2 | 8.48 | 5.65 | 0.58 | 2684 | 0.09 | 0.60 | 0.53 | 447 | 0.55 |
| 2 | 3 | 6.46 | 5.23 | 0.59 | 2745 | 0.07 | 0.61 | 0.53 | 458 | 0.41 |
| | 4 | 5.40 | 4.99 | 0.60 | 2790 | 0.06 | 0.60 | 0.54 | 465 | 0.34 |
| | High | 5.01 | 5.22 | 0.59 | 2818 | 0.05 | 0.61 | 0.54 | 470 | 0.31 |
| | Low | 8.75 | 6.61 | 0.57 | 2768 | 0.09 | 0.60 | 0.53 | 461 | 0.55 |
| | 2 | 6.64 | 6.09 | 0.58 | 2804 | 0.07 | 0.60 | 0.53 | 467 | 0.41 |
| 3 | 3 | 5.09 | 5.93 | 0.59 | 2876 | 0.05 | 0.60 | 0.53 | 479 | 0.31 |
| | 4 | 4.17 | 5.62 | 0.59 | 2886 | 0.04 | 0.60 | 0.52 | 481 | 0.25 |
| | High | 4.72 | 5.68 | 0.59 | 2805 | 0.05 | 0.59 | 0.53 | 468 | 0.29 |
| | Low | 6.78 | 6.87 | 0.58 | 2880 | 0.07 | 0.60 | 0.52 | 480 | 0.41 |
| | 2 | 4.01 | 6.14 | 0.59 | 2943 | 0.04 | 0.59 | 0.53 | 490 | 0.24 |
| 4 | 3 | 3.57 | 6.25 | 0.59 | 2949 | 0.04 | 0.59 | 0.52 | 492 | 0.21 |
| | 4 | 3.11 | 6.01 | 0.59 | 2958 | 0.03 | 0.59 | 0.53 | 493 | 0.18 |
| | High | 4.80 | 6.55 | 0.58 | 2925 | 0.05 | 0.58 | 0.52 | 488 | 0.29 |
| | Low | 3.07 | 7.71 | 0.59 | 3071 | 0.03 | 0.58 | 0.52 | 512 | 0.17 |
| | 2 | 1.23 | 6.97 | 0.59 | 3078 | 0.01 | 0.58 | 0.52 | 513 | 0.07 |
| Big | 3 | 1.36 | 7.36 | 0.60 | 3112 | 0.01 | 0.57 | 0.53 | 519 | 0.08 |
| | 4 | 1.21 | 7.62 | 0.61 | 3087 | 0.01 | 0.56 | 0.53 | 514 | 0.07 |
| | High | 1.59 | 9.20 | 0.59 | 3101 | 0.01 | 0.56 | 0.52 | 517 | 0.09 |

The Japan Index in Table 22 also provides considerable risk reduction across all quintiles. The minimum total days not trading is 51%. Following a buy a positive return occurs at a minimum 56% and the return is above the risk-free rate a minimum 50% of the time. The adjusted *BETC*6* is between -30 and 95 basis points corresponding to the wide range of performance for the Japan Index.

**Table 22: Summary Trading Statistics for Value Weighted Japan Index**

Value Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 14.68 | 9.91 | 0.52 | 2694 | 0.16 | 0.63 | 0.51 | 449 | 0.95 |
| | 2 | 9.75 | 8.50 | 0.54 | 2859 | 0.10 | 0.63 | 0.52 | 476 | 0.59 |
| Small | 3 | 9.07 | 8.12 | 0.54 | 2857 | 0.09 | 0.63 | 0.52 | 476 | 0.55 |
| | 4 | 7.81 | 7.67 | 0.55 | 2926 | 0.08 | 0.63 | 0.52 | 488 | 0.47 |
| | High | 7.46 | 7.16 | 0.54 | 2891 | 0.07 | 0.63 | 0.52 | 482 | 0.45 |
| | Low | 10.64 | 10.35 | 0.51 | 2884 | 0.11 | 0.62 | 0.51 | 481 | 0.64 |
| | 2 | 8.18 | 9.57 | 0.52 | 3066 | 0.08 | 0.62 | 0.51 | 511 | 0.47 |
| 2 | 3 | 5.72 | 8.96 | 0.53 | 3090 | 0.05 | 0.61 | 0.51 | 515 | 0.32 |
| | 4 | 3.53 | 8.65 | 0.55 | 3123 | 0.03 | 0.61 | 0.52 | 520 | 0.20 |
| | High | 4.08 | 8.97 | 0.53 | 3061 | 0.04 | 0.60 | 0.51 | 510 | 0.23 |
| | Low | 9.72 | 10.89 | 0.51 | 3004 | 0.09 | 0.61 | 0.51 | 501 | 0.56 |
| | 2 | 3.04 | 10.12 | 0.54 | 3175 | 0.03 | 0.60 | 0.52 | 529 | 0.17 |
| 3 | 3 | 2.58 | 9.50 | 0.54 | 3094 | 0.02 | 0.61 | 0.51 | 516 | 0.15 |
| | 4 | 0.51 | 9.08 | 0.54 | 3166 | 0.00 | 0.59 | 0.51 | 528 | 0.03 |
| | High | 0.45 | 9.05 | 0.54 | 3193 | 0.00 | 0.60 | 0.51 | 532 | 0.02 |
| | Low | 5.29 | 11.02 | 0.50 | 3173 | 0.05 | 0.60 | 0.50 | 529 | 0.29 |
| | 2 | -1.52 | 9.73 | 0.54 | 3285 | -0.01 | 0.60 | 0.51 | 548 | -0.08 |
| 4 | 3 | -2.87 | 9.38 | 0.54 | 3287 | -0.03 | 0.59 | 0.51 | 548 | -0.15 |
| | 4 | -2.86 | 9.29 | 0.53 | 3270 | -0.03 | 0.59 | 0.51 | 545 | -0.15 |
| | High | -2.62 | 9.74 | 0.53 | 3254 | -0.02 | 0.58 | 0.50 | 542 | -0.14 |
| | Low | -1.68 | 11.27 | 0.52 | 3293 | -0.01 | 0.58 | 0.50 | 549 | -0.09 |
| | 2 | -4.77 | 10.04 | 0.53 | 3404 | -0.04 | 0.57 | 0.50 | 567 | -0.24 |
| Big | 3 | -3.57 | 10.34 | 0.53 | 3346 | -0.03 | 0.57 | 0.50 | 558 | -0.19 |
| | 4 | -5.74 | 9.91 | 0.53 | 3472 | -0.05 | 0.57 | 0.51 | 579 | -0.29 |
| | High | -5.89 | 11.04 | 0.52 | 3391 | -0.05 | 0.56 | 0.50 | 565 | -0.30 |

The Asia Pacific excluding Japan Index in Table 23 also provides considerable risk reduction across all quintiles. The minimum total days not trading is 50%. Following a buy a positive return occurs at a minimum 56% and the return is above the risk-free rate a minimum 51% of the time. The adjusted *BETC*6* is between 14 and 110 basis points.

**Table 23: Summary Trading Statistics for Value Weighted Asia Pacific excl. Japan Index**

Value Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 16.31 | 7.22 | 0.53 | 2593 | 0.18 | 0.58 | 0.52 | 432 | 1.10 |
| | 2 | 16.01 | 7.18 | 0.55 | 2544 | 0.18 | 0.59 | 0.52 | 424 | 1.10 |
| Small | 3 | 12.80 | 6.72 | 0.57 | 2515 | 0.15 | 0.59 | 0.53 | 419 | 0.89 |
| | 4 | 11.46 | 5.48 | 0.60 | 2511 | 0.13 | 0.59 | 0.55 | 418 | 0.80 |
| | High | 11.41 | 4.78 | 0.62 | 2299 | 0.14 | 0.62 | 0.57 | 383 | 0.86 |
| | Low | 14.95 | 7.99 | 0.50 | 2721 | 0.16 | 0.58 | 0.51 | 454 | 0.96 |
| | 2 | 14.09 | 7.64 | 0.53 | 2628 | 0.16 | 0.58 | 0.52 | 438 | 0.93 |
| 2 | 3 | 11.61 | 6.98 | 0.57 | 2642 | 0.13 | 0.58 | 0.53 | 440 | 0.77 |
| | 4 | 11.48 | 6.75 | 0.59 | 2582 | 0.13 | 0.59 | 0.54 | 430 | 0.77 |
| | High | 11.45 | 6.37 | 0.60 | 2548 | 0.13 | 0.60 | 0.55 | 425 | 0.78 |
| | Low | 12.71 | 8.63 | 0.55 | 2761 | 0.13 | 0.58 | 0.53 | 460 | 0.80 |
| | 2 | 9.50 | 7.51 | 0.59 | 2851 | 0.10 | 0.57 | 0.53 | 475 | 0.58 |
| 3 | 3 | 8.11 | 7.28 | 0.60 | 2787 | 0.08 | 0.57 | 0.53 | 464 | 0.51 |
| | 4 | 9.21 | 6.53 | 0.60 | 2740 | 0.10 | 0.58 | 0.54 | 457 | 0.59 |
| | High | 10.60 | 6.73 | 0.61 | 2633 | 0.12 | 0.60 | 0.54 | 439 | 0.70 |
| | Low | 6.36 | 7.70 | 0.60 | 2903 | 0.06 | 0.57 | 0.54 | 484 | 0.38 |
| | 2 | 5.43 | 6.99 | 0.62 | 2817 | 0.06 | 0.57 | 0.53 | 470 | 0.34 |
| 4 | 3 | 5.33 | 7.91 | 0.60 | 2872 | 0.05 | 0.58 | 0.53 | 479 | 0.32 |
| | 4 | 5.22 | 6.98 | 0.62 | 2737 | 0.06 | 0.57 | 0.54 | 456 | 0.33 |
| | High | 8.72 | 7.30 | 0.61 | 2685 | 0.09 | 0.59 | 0.55 | 448 | 0.57 |
| | Low | 3.79 | 9.62 | 0.60 | 2985 | 0.04 | 0.56 | 0.52 | 498 | 0.22 |
| | 2 | 2.62 | 8.22 | 0.62 | 2915 | 0.03 | 0.56 | 0.53 | 486 | 0.16 |
| Big | 3 | 2.42 | 8.43 | 0.61 | 2980 | 0.02 | 0.56 | 0.53 | 497 | 0.14 |
| | 4 | 3.30 | 7.77 | 0.61 | 2872 | 0.03 | 0.56 | 0.53 | 479 | 0.20 |
| | High | 4.81 | 9.11 | 0.59 | 2865 | 0.05 | 0.56 | 0.52 | 478 | 0.29 |

The Europe Index in Table 24 also provides considerable risk reduction across all quintiles. The minimum total days not trading is 56%. Following a buy a positive return occurs at a minimum 55% and the return is above the risk-free rate a minimum 52% of the time. The adjusted *BETC*6* is between -19 and 71 basis points.

**Table 24: Summary Trading Statistics for Value Weighted Europe Index**

Value Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 10.86 | 6.13 | 0.56 | 2682 | 0.12 | 0.58 | 0.52 | 447 | 0.71 |
| | 2 | 8.25 | 5.51 | 0.60 | 2747 | 0.09 | 0.59 | 0.53 | 458 | 0.52 |
| Small | 3 | 6.43 | 5.11 | 0.60 | 2741 | 0.07 | 0.59 | 0.54 | 457 | 0.41 |
| | 4 | 5.86 | 4.81 | 0.62 | 2743 | 0.06 | 0.58 | 0.54 | 457 | 0.37 |
| | High | 5.02 | 4.45 | 0.62 | 2742 | 0.05 | 0.57 | 0.54 | 457 | 0.32 |
| | Low | 8.26 | 6.83 | 0.59 | 2799 | 0.09 | 0.59 | 0.53 | 466 | 0.51 |
| | 2 | 5.81 | 6.19 | 0.61 | 2820 | 0.06 | 0.59 | 0.54 | 470 | 0.36 |
| 2 | 3 | 5.03 | 5.84 | 0.61 | 2809 | 0.05 | 0.58 | 0.53 | 468 | 0.31 |
| | 4 | 4.42 | 5.78 | 0.62 | 2835 | 0.05 | 0.58 | 0.54 | 472 | 0.27 |
| | High | 4.44 | 5.89 | 0.61 | 2846 | 0.05 | 0.57 | 0.54 | 474 | 0.27 |
| | Low | 5.38 | 7.68 | 0.61 | 2946 | 0.05 | 0.59 | 0.53 | 491 | 0.32 |
| | 2 | 3.91 | 7.05 | 0.62 | 2928 | 0.04 | 0.58 | 0.53 | 488 | 0.23 |
| 3 | 3 | 3.05 | 6.82 | 0.61 | 2957 | 0.03 | 0.58 | 0.53 | 493 | 0.18 |
| | 4 | 2.84 | 6.66 | 0.60 | 3010 | 0.03 | 0.58 | 0.53 | 502 | 0.16 |
| | High | 3.99 | 7.01 | 0.62 | 2858 | 0.04 | 0.57 | 0.53 | 476 | 0.24 |
| | Low | 1.77 | 7.93 | 0.62 | 3019 | 0.02 | 0.59 | 0.53 | 503 | 0.10 |
| | 2 | 0.45 | 7.37 | 0.62 | 3056 | 0.00 | 0.57 | 0.53 | 509 | 0.03 |
| 4 | 3 | 0.47 | 7.37 | 0.61 | 3121 | 0.00 | 0.57 | 0.53 | 520 | 0.03 |
| | 4 | 1.72 | 7.71 | 0.60 | 3040 | 0.02 | 0.58 | 0.53 | 507 | 0.10 |
| | High | 2.86 | 8.68 | 0.61 | 2944 | 0.03 | 0.56 | 0.53 | 491 | 0.17 |
| | Low | -2.51 | 8.72 | 0.61 | 3263 | -0.02 | 0.56 | 0.52 | 544 | -0.13 |
| | 2 | -3.16 | 7.89 | 0.62 | 3173 | -0.03 | 0.56 | 0.53 | 529 | -0.17 |
| Big | 3 | -2.01 | 8.78 | 0.62 | 3130 | -0.02 | 0.55 | 0.53 | 522 | -0.11 |
| | 4 | -3.45 | 9.31 | 0.62 | 3204 | -0.03 | 0.55 | 0.53 | 534 | -0.19 |
| | High | -0.33 | 11.07 | 0.59 | 3171 | 0.00 | 0.55 | 0.52 | 528 | -0.02 |

The North America Index in Table 25 also provides considerable risk reduction across all quintiles. The minimum total days not trading is 57%. Following a buy a positive return occurs at a minimum 56% and the return is above the risk-free rate a minimum 53% of the time. The adjusted *BETC*6* is between -20 and 58 basis points.

**Table 25: Summary Trading Statistics for Value Weighted North America Index**

Value Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 9.10 | 10.29 | 0.57 | 2739 | 0.10 | 0.60 | 0.55 | 456 | 0.58 |
| | 2 | 5.06 | 9.04 | 0.61 | 2769 | 0.05 | 0.60 | 0.55 | 462 | 0.32 |
| Small | 3 | 2.11 | 7.91 | 0.64 | 2770 | 0.02 | 0.59 | 0.56 | 462 | 0.13 |
| | 4 | 0.75 | 7.31 | 0.64 | 2835 | 0.01 | 0.59 | 0.56 | 472 | 0.05 |
| | High | 1.21 | 6.97 | 0.67 | 2643 | 0.01 | 0.59 | 0.58 | 440 | 0.08 |
| | Low | 3.57 | 11.19 | 0.59 | 2941 | 0.04 | 0.59 | 0.54 | 490 | 0.21 |
| | 2 | 0.61 | 9.60 | 0.61 | 2977 | 0.01 | 0.59 | 0.54 | 496 | 0.04 |
| 2 | 3 | -2.89 | 8.23 | 0.64 | 2968 | -0.03 | 0.58 | 0.55 | 495 | -0.17 |
| | 4 | -3.48 | 8.05 | 0.65 | 2965 | -0.03 | 0.57 | 0.55 | 494 | -0.20 |
| | High | -2.29 | 8.29 | 0.65 | 2877 | -0.02 | 0.56 | 0.55 | 480 | -0.14 |
| | Low | 0.76 | 10.61 | 0.62 | 2993 | 0.01 | 0.58 | 0.54 | 499 | 0.04 |
| | 2 | -0.48 | 9.32 | 0.63 | 2999 | 0.00 | 0.59 | 0.54 | 500 | -0.03 |
| 3 | 3 | -2.11 | 7.86 | 0.65 | 2921 | -0.02 | 0.57 | 0.54 | 487 | -0.13 |
| | 4 | -1.95 | 7.61 | 0.65 | 2956 | -0.02 | 0.57 | 0.55 | 493 | -0.12 |
| | High | -1.80 | 7.87 | 0.65 | 2919 | -0.02 | 0.57 | 0.55 | 486 | -0.11 |
| | Low | -0.84 | 10.73 | 0.64 | 3035 | -0.01 | 0.58 | 0.54 | 506 | -0.05 |
| | 2 | -2.41 | 8.42 | 0.65 | 3045 | -0.02 | 0.58 | 0.54 | 508 | -0.14 |
| 4 | 3 | -2.76 | 7.51 | 0.66 | 3005 | -0.03 | 0.57 | 0.55 | 501 | -0.16 |
| | 4 | -1.33 | 7.67 | 0.66 | 2927 | -0.01 | 0.57 | 0.55 | 488 | -0.08 |
| | High | -1.41 | 8.08 | 0.66 | 2909 | -0.01 | 0.57 | 0.55 | 485 | -0.08 |
| | Low | -4.86 | 8.29 | 0.65 | 3065 | -0.05 | 0.57 | 0.53 | 511 | -0.28 |
| | 2 | -4.82 | 7.63 | 0.65 | 3112 | -0.04 | 0.56 | 0.53 | 519 | -0.27 |
| Big | 3 | -4.39 | 7.92 | 0.66 | 3073 | -0.04 | 0.56 | 0.53 | 512 | -0.25 |
| | 4 | -3.82 | 7.82 | 0.65 | 3117 | -0.04 | 0.56 | 0.53 | 520 | -0.21 |
| | High | -3.53 | 10.47 | 0.63 | 3109 | -0.03 | 0.56 | 0.53 | 518 | -0.20 |

Across all 6 indices it is interesting to note the minimum and maximum value for *pA* at 51% and 67% respectively. The implication here is irrespective of characteristics and excess returns, an investor will always hold a position for a greater proportion of days than change position (to buy or sell) when using the MA. Additionally, the minimum and maximum value for *p1* is 55% and 63% whilst the minimum and maximum value for *p2* is 50% and 58%. Therefore, an investor utilising an MA strategy will correctly buy into the investment at worst 55% of the time, whereby at a minimum 50% of these buy-ins will result in a return in excess of the risk-free rate.

When analysing *pA* in conjunction with *p1* and *p2* a clear picture begins to emerge. The MA is clearly successful in assisting an investor to determine when to buy, sell or hold. While the MA does not perform with perfect accuracy the data shows it improves the performance on average. This is further evidenced when reviewing the $\Delta\mu$ and $\Delta\sigma$. While the mean performance differential is considerable, it does diminish as size increases. However, the risk reducing benefits of utilising the MA do not diminish. This highlights that even if an investor was unable to beat a BH strategy using an MA on average performance, the MA still provides risk reducing benefits.

The *NT* and *BETC* values are not as informative as they include all trades across all six MAs used. When reviewing the adjusted *NT/6* and *BETC*6* values, it is clear the results for the smaller capitalised stocks corresponding to the highest abnormal excess returns have considerably high *BETC* values. While each individual investor will incur slightly different transaction costs, the academic rule of thumb is to apply a transaction cost between 1 and 50 basis points per trade (Balduzzi & Lynch 1999). Assuming the worst-case scenario of 50 basis points is taken, the smallest size firms will still achieve a significant abnormal return after cost when utilising the MA.

The tables show a clear case for the MA strategy supporting the findings in Section 2.3.2.

## 2.4 Equal Weighted Results

The results analysed in this section relate to the indices weighted equally. The weight of each asset is found by equally distributing the investment across all assets in the index, irrespective of size and other factors.

### 2.4.1 Summary Statistics

The following tables (Table 26-31) report the Summary Statistics for the equal weighted indices. Table 26 represents the Developed Index. Table 27 represents the Developed excluding US Index. Table 28 represents the Japan Index. Table 29 represents the Asia Pacific excluding Japan Index. Table 30 represents the Europe Index. Table 31 represents the North America Index. The country composition for each index is as seen in Table 1, Section 2.2.

Each table contains statistics on the BH, MA and TIS portfolios, with the reported variables the same as seen in Section 2.3 with quintiles grouped by size and book-to-market.

The Developed Index including and excluding the US (refer to Table 26 and 27) shows a sizeable reduction in risk as evidenced by the SRs, which are higher for all MA quintiles compared to the BH. There is also a performance reduction as the size of the quintiles increase, although it is not entirely consistent.

With regards to book-to-market relative to performance, there is a clear increase in performance for higher levels of book-to-market for the smallest size category, although this does not hold consistently as size increases. For quintiles where performance increases for higher book-to-market levels the risk reducing benefits of the MA is higher, thus improving the *SR*. This relationship does not hold as firm size increases.

**Table 26: Summary Statistics for Equal Weighted Developed Index**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 17.37 | 11.69 | -0.70 | 8.93 | 1.28 | 25.10 | 6.96 | 0.34 | 7.61 | 3.26 | 7.72 | 7.75 | 1.73 | 26.97 | 1.00 |
| | 2 | 17.89 | 11.38 | -0.78 | 10.77 | 1.36 | 25.41 | 6.79 | 0.27 | 7.70 | 3.39 | 7.52 | 7.53 | 1.92 | 36.02 | 1.00 |
| Small | 3 | 19.31 | 10.56 | -0.77 | 10.49 | 1.60 | 24.77 | 6.57 | 0.13 | 8.07 | 3.40 | 5.46 | 6.73 | 1.90 | 39.38 | 0.81 |
| | 4 | 20.42 | 9.92 | -0.78 | 10.57 | 1.82 | 25.04 | 6.32 | 0.26 | 7.50 | 3.58 | 4.62 | 6.16 | 2.14 | 41.67 | 0.75 |
| | High | 29.29 | 8.91 | -0.78 | 10.29 | 3.02 | 31.56 | 6.21 | 0.22 | 6.33 | 4.69 | 2.27 | 4.96 | 2.31 | 53.19 | 0.46 |
| | Low | 6.93 | 14.89 | -0.31 | 8.33 | 0.31 | 16.79 | 7.93 | 0.19 | 9.51 | 1.82 | 9.86 | 10.56 | 0.85 | 19.96 | 0.93 |
| | 2 | 9.70 | 13.46 | -0.48 | 8.99 | 0.54 | 16.77 | 7.50 | 0.02 | 8.58 | 1.92 | 7.07 | 9.28 | 1.20 | 25.15 | 0.76 |
| 2 | 3 | 11.12 | 12.67 | -0.35 | 9.37 | 0.69 | 15.81 | 7.26 | 0.00 | 9.24 | 1.85 | 4.70 | 8.58 | 0.89 | 27.48 | 0.55 |
| | 4 | 12.29 | 12.40 | -0.39 | 9.35 | 0.80 | 16.05 | 7.30 | 0.02 | 8.89 | 1.87 | 3.76 | 8.21 | 1.11 | 28.11 | 0.46 |
| | High | 13.10 | 12.46 | -0.35 | 8.31 | 0.86 | 17.13 | 7.40 | 0.14 | 8.50 | 1.99 | 4.03 | 8.14 | 0.99 | 24.09 | 0.50 |
| | Low | 7.51 | 15.72 | -0.21 | 8.91 | 0.33 | 14.82 | 8.21 | -0.06 | 8.39 | 1.51 | 7.31 | 11.30 | 0.48 | 21.26 | 0.65 |
| | 2 | 8.44 | 14.47 | -0.32 | 9.17 | 0.42 | 14.36 | 7.82 | -0.09 | 9.44 | 1.53 | 5.92 | 10.20 | 0.72 | 22.88 | 0.58 |
| 3 | 3 | 10.79 | 13.86 | -0.29 | 9.72 | 0.61 | 14.24 | 7.88 | -0.10 | 9.35 | 1.50 | 3.45 | 9.40 | 0.64 | 27.90 | 0.37 |
| | 4 | 11.07 | 13.38 | -0.37 | 10.77 | 0.65 | 14.72 | 7.61 | -0.11 | 12.17 | 1.62 | 3.65 | 9.13 | 0.71 | 30.07 | 0.40 |
| | High | 12.18 | 13.64 | -0.34 | 9.32 | 0.72 | 15.90 | 7.88 | -0.07 | 10.54 | 1.71 | 3.72 | 9.14 | 0.90 | 26.65 | 0.41 |
| | Low | 10.83 | 16.24 | -0.13 | 9.81 | 0.52 | 16.40 | 8.79 | -0.06 | 10.29 | 1.59 | 5.57 | 11.42 | 0.18 | 24.92 | 0.49 |
| | 2 | 12.10 | 14.79 | -0.04 | 11.72 | 0.66 | 15.12 | 8.54 | 0.26 | 12.57 | 1.49 | 3.02 | 9.99 | 0.00 | 33.38 | 0.30 |
| 4 | 3 | 11.06 | 14.08 | -0.28 | 10.57 | 0.62 | 14.25 | 7.89 | -0.14 | 10.97 | 1.50 | 3.20 | 9.65 | 0.45 | 28.98 | 0.33 |
| | 4 | 11.03 | 13.75 | -0.32 | 11.50 | 0.63 | 13.97 | 7.70 | -0.15 | 11.56 | 1.50 | 2.94 | 9.45 | 0.57 | 32.98 | 0.31 |
| | High | 11.73 | 14.69 | -0.24 | 12.29 | 0.64 | 15.24 | 8.16 | -0.16 | 12.55 | 1.57 | 3.51 | 10.20 | 0.35 | 35.34 | 0.34 |
| | Low | 8.38 | 15.48 | -0.02 | 12.81 | 0.39 | 11.30 | 8.03 | -0.14 | 9.42 | 1.11 | 2.92 | 11.12 | -0.19 | 31.32 | 0.26 |
| | 2 | 14.50 | 14.82 | 0.09 | 13.01 | 0.82 | 14.24 | 8.74 | 0.32 | 11.95 | 1.36 | -0.25 | 9.88 | -0.41 | 40.96 | -0.03 |
| Big | 3 | 12.64 | 14.52 | -0.21 | 12.48 | 0.71 | 13.72 | 8.28 | -0.14 | 10.52 | 1.37 | 1.07 | 9.84 | 0.05 | 36.60 | 0.11 |
| | 4 | 11.62 | 14.98 | -0.09 | 14.29 | 0.62 | 12.87 | 8.32 | -0.10 | 12.52 | 1.26 | 1.25 | 10.40 | -0.18 | 40.53 | 0.12 |
| | High | 16.71 | 16.81 | 0.01 | 13.16 | 0.85 | 16.73 | 9.79 | -0.05 | 14.65 | 1.47 | 0.02 | 11.17 | -0.34 | 38.72 | 0.00 |

**Table 27: Summary Statistics for Equal Weighted Developed excl. US Index**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 17.79 | 11.86 | -0.64 | 8.52 | 1.30 | 24.96 | 7.31 | 0.39 | 7.64 | 3.08 | 7.17 | 7.64 | 1.82 | 28.54 | 0.94 |
| | 2 | 17.24 | 11.66 | -0.75 | 10.24 | 1.27 | 24.21 | 7.17 | 0.26 | 7.53 | 3.04 | 6.97 | 7.57 | 2.03 | 36.72 | 0.92 |
| Small | 3 | 18.03 | 11.12 | -0.78 | 10.50 | 1.41 | 23.28 | 7.02 | 0.13 | 7.61 | 2.97 | 5.24 | 7.02 | 2.02 | 40.22 | 0.75 |
| | 4 | 20.63 | 10.52 | -0.77 | 10.03 | 1.73 | 24.72 | 6.90 | 0.18 | 6.89 | 3.24 | 4.10 | 6.35 | 2.27 | 43.13 | 0.64 |
| | High | 28.53 | 9.68 | -0.65 | 9.83 | 2.70 | 30.16 | 6.88 | 0.23 | 5.90 | 4.03 | 1.63 | 5.27 | 1.93 | 55.15 | 0.31 |
| | Low | 4.21 | 14.47 | -0.33 | 9.13 | 0.13 | 15.75 | 7.69 | 0.48 | 10.79 | 1.74 | 11.54 | 10.36 | 0.97 | 22.72 | 1.11 |
| | 2 | 6.62 | 13.25 | -0.51 | 10.13 | 0.32 | 14.69 | 7.31 | 0.32 | 10.14 | 1.68 | 8.07 | 9.34 | 1.34 | 28.77 | 0.86 |
| 2 | 3 | 10.28 | 12.85 | -0.22 | 10.22 | 0.61 | 16.04 | 7.54 | 0.71 | 12.06 | 1.81 | 5.76 | 8.60 | 1.15 | 30.74 | 0.67 |
| | 4 | 10.54 | 12.21 | -0.50 | 8.53 | 0.67 | 15.57 | 7.17 | 0.08 | 7.24 | 1.84 | 5.03 | 8.14 | 1.35 | 27.82 | 0.62 |
| | High | 12.21 | 12.74 | -0.41 | 8.60 | 0.77 | 16.56 | 7.61 | 0.08 | 6.93 | 1.86 | 4.35 | 8.28 | 0.87 | 27.25 | 0.53 |
| | Low | 5.78 | 15.09 | -0.29 | 8.71 | 0.23 | 14.09 | 8.13 | 0.34 | 11.34 | 1.44 | 8.31 | 10.72 | 0.90 | 21.54 | 0.77 |
| | 2 | 6.74 | 14.03 | -0.52 | 9.62 | 0.31 | 13.51 | 7.67 | -0.14 | 10.21 | 1.45 | 6.77 | 9.85 | 1.16 | 26.37 | 0.69 |
| 3 | 3 | 9.22 | 13.96 | -0.24 | 10.28 | 0.49 | 13.27 | 7.89 | -0.15 | 10.60 | 1.38 | 4.05 | 9.59 | 0.44 | 30.39 | 0.42 |
| | 4 | 9.91 | 13.48 | -0.34 | 9.61 | 0.56 | 13.82 | 7.79 | 0.10 | 9.29 | 1.47 | 3.91 | 9.16 | 0.86 | 30.10 | 0.43 |
| | High | 11.60 | 13.91 | -0.28 | 8.07 | 0.66 | 15.99 | 8.16 | 0.09 | 7.86 | 1.67 | 4.39 | 9.20 | 0.74 | 25.81 | 0.48 |
| | Low | 7.65 | 15.86 | -0.23 | 9.28 | 0.33 | 14.09 | 8.74 | -0.09 | 9.54 | 1.34 | 6.44 | 11.09 | 0.66 | 23.96 | 0.58 |
| | 2 | 9.07 | 14.77 | -0.30 | 9.93 | 0.45 | 12.57 | 8.30 | -0.04 | 8.70 | 1.23 | 3.50 | 10.15 | 0.60 | 28.82 | 0.34 |
| 4 | 3 | 10.62 | 14.64 | -0.26 | 8.61 | 0.56 | 13.14 | 8.48 | -0.01 | 9.31 | 1.27 | 2.52 | 9.84 | 0.54 | 25.91 | 0.26 |
| | 4 | 9.99 | 14.39 | -0.27 | 8.80 | 0.53 | 12.57 | 8.26 | -0.09 | 12.10 | 1.23 | 2.58 | 9.76 | 0.55 | 25.16 | 0.26 |
| | High | 9.54 | 15.20 | -0.23 | 8.73 | 0.47 | 14.24 | 8.57 | -0.14 | 11.86 | 1.38 | 4.70 | 10.45 | 0.46 | 24.43 | 0.45 |
| | Low | 7.59 | 15.87 | -0.03 | 9.34 | 0.33 | 11.04 | 8.66 | -0.08 | 8.63 | 1.00 | 3.45 | 11.13 | -0.05 | 25.01 | 0.31 |
| | 2 | 17.85 | 16.24 | 0.45 | 11.36 | 0.95 | 16.15 | 10.44 | 1.00 | 16.63 | 1.32 | -1.70 | 9.99 | -0.57 | 36.83 | -0.17 |
| Big | 3 | 11.97 | 15.66 | -0.14 | 10.38 | 0.61 | 12.68 | 8.97 | 0.04 | 10.38 | 1.15 | 0.71 | 10.65 | 0.06 | 31.76 | 0.07 |
| | 4 | 11.53 | 16.24 | -0.04 | 10.92 | 0.56 | 12.35 | 9.19 | 0.04 | 12.03 | 1.09 | 0.82 | 11.18 | -0.16 | 32.01 | 0.07 |
| | High | 20.92 | 18.70 | 0.12 | 10.40 | 0.99 | 18.54 | 11.57 | 0.21 | 11.71 | 1.40 | -2.38 | 11.88 | -0.53 | 36.14 | -0.20 |

**Table 28: Summary Statistics for Equal Weighted Japan Index**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 11.91 | 21.93 | -0.47 | 10.59 | 0.43 | 23.81 | 12.41 | -0.15 | 11.06 | 1.73 | 11.90 | 14.60 | 0.67 | 22.90 | 0.81 |
| | 2 | 12.27 | 19.42 | -0.41 | 11.72 | 0.51 | 21.43 | 11.42 | 0.18 | 16.32 | 1.67 | 9.15 | 12.55 | 0.63 | 25.44 | 0.73 |
| Small | 3 | 11.62 | 18.04 | -0.35 | 10.47 | 0.51 | 19.79 | 10.61 | -0.12 | 9.29 | 1.64 | 8.17 | 11.60 | 0.44 | 26.65 | 0.70 |
| | 4 | 12.49 | 17.57 | -0.24 | 11.81 | 0.58 | 19.67 | 10.36 | -0.02 | 8.29 | 1.67 | 7.18 | 11.23 | -0.06 | 30.88 | 0.64 |
| | High | 13.65 | 16.66 | -0.24 | 11.61 | 0.68 | 20.20 | 10.15 | -0.01 | 9.18 | 1.75 | 6.55 | 10.35 | -0.12 | 30.83 | 0.63 |
| | Low | 4.79 | 23.50 | 0.11 | 13.55 | 0.10 | 15.42 | 12.31 | -0.05 | 9.02 | 1.06 | 10.62 | 16.42 | -0.01 | 22.20 | 0.65 |
| | 2 | 4.37 | 20.90 | -0.18 | 9.29 | 0.10 | 11.91 | 11.23 | -0.17 | 8.92 | 0.85 | 7.54 | 14.45 | 0.26 | 21.73 | 0.52 |
| 2 | 3 | 5.90 | 19.75 | -0.01 | 10.28 | 0.18 | 10.83 | 10.74 | -0.16 | 8.22 | 0.79 | 4.93 | 13.65 | -0.19 | 27.97 | 0.36 |
| | 4 | 8.06 | 19.72 | -0.12 | 9.05 | 0.29 | 11.38 | 11.13 | -0.32 | 8.46 | 0.81 | 3.32 | 13.28 | -0.04 | 23.94 | 0.25 |
| | High | 8.35 | 20.12 | -0.04 | 9.80 | 0.30 | 11.67 | 11.36 | -0.17 | 9.01 | 0.82 | 3.31 | 13.42 | -0.20 | 24.54 | 0.25 |
| | Low | 1.42 | 22.96 | -0.17 | 7.34 | -0.04 | 11.29 | 11.78 | -0.14 | 8.60 | 0.76 | 9.87 | 16.53 | 0.27 | 16.07 | 0.60 |
| | 2 | 5.59 | 21.70 | -0.10 | 9.05 | 0.15 | 8.06 | 11.58 | -0.22 | 7.98 | 0.49 | 2.47 | 15.21 | 0.01 | 21.59 | 0.16 |
| 3 | 3 | 6.01 | 21.20 | 0.00 | 9.47 | 0.17 | 8.31 | 11.51 | -0.20 | 7.95 | 0.52 | 2.31 | 14.59 | -0.22 | 23.86 | 0.16 |
| | 4 | 7.02 | 20.49 | -0.06 | 8.08 | 0.23 | 6.72 | 11.48 | -0.33 | 7.73 | 0.38 | -0.30 | 13.90 | -0.06 | 21.56 | -0.02 |
| | High | 9.07 | 21.10 | 0.06 | 8.76 | 0.32 | 8.86 | 12.22 | -0.11 | 8.53 | 0.53 | -0.20 | 13.88 | -0.18 | 23.05 | -0.01 |
| | Low | 2.19 | 22.96 | -0.01 | 7.58 | -0.01 | 7.86 | 11.93 | -0.16 | 8.74 | 0.46 | 5.66 | 16.37 | -0.16 | 16.80 | 0.35 |
| | 2 | 6.14 | 21.93 | 0.00 | 8.51 | 0.17 | 4.26 | 12.04 | -0.32 | 7.75 | 0.16 | -1.88 | 15.08 | -0.24 | 20.08 | -0.12 |
| 4 | 3 | 6.06 | 21.16 | -0.01 | 8.12 | 0.17 | 3.27 | 11.66 | -0.37 | 7.74 | 0.08 | -2.80 | 14.47 | -0.22 | 18.44 | -0.19 |
| | 4 | 7.79 | 21.01 | -0.01 | 8.19 | 0.26 | 4.80 | 11.84 | -0.25 | 7.48 | 0.20 | -2.99 | 14.09 | -0.25 | 21.79 | -0.21 |
| | High | 8.03 | 22.21 | 0.12 | 8.33 | 0.25 | 5.39 | 12.55 | -0.17 | 8.63 | 0.24 | -2.63 | 14.75 | -0.33 | 19.07 | -0.18 |
| | Low | 3.75 | 23.22 | 0.13 | 8.05 | 0.06 | 2.99 | 12.34 | -0.08 | 8.05 | 0.05 | -0.76 | 16.40 | -0.34 | 17.16 | -0.05 |
| | 2 | 6.35 | 21.65 | 0.11 | 8.14 | 0.18 | 1.44 | 12.04 | -0.19 | 7.81 | -0.08 | -4.91 | 14.76 | -0.43 | 19.80 | -0.33 |
| Big | 3 | 6.50 | 22.01 | 0.13 | 9.20 | 0.19 | 1.66 | 12.26 | -0.08 | 7.77 | -0.06 | -4.83 | 14.99 | -0.59 | 22.55 | -0.32 |
| | 4 | 8.40 | 22.21 | 0.06 | 7.77 | 0.27 | 3.32 | 12.63 | -0.11 | 7.95 | 0.07 | -5.09 | 14.72 | -0.41 | 19.40 | -0.35 |
| | High | 9.62 | 25.21 | 0.25 | 8.89 | 0.29 | 4.14 | 14.36 | 0.23 | 10.25 | 0.12 | -5.48 | 16.85 | -0.59 | 21.95 | -0.33 |

**Table 29: Summary Statistics for Equal Weighted Asia Pacific excl. Japan Index**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | $s$ | $k$ | $SR$ | $\mu$ | $\sigma$ | $s$ | $k$ | $SR$ | $\mu$ | $\sigma$ | $s$ | $k$ | $SR$ |
| | Low | 30.42 | 18.21 | -0.06 | 19.95 | 1.54 | 36.06 | 11.91 | 2.46 | 32.63 | 2.83 | 5.64 | 11.11 | 2.47 | 54.48 | 0.51 |
| | 2 | 27.75 | 16.83 | -0.64 | 13.39 | 1.51 | 35.17 | 10.66 | 0.75 | 10.05 | 3.08 | 7.42 | 10.56 | 2.16 | 50.75 | 0.70 |
| Small | 3 | 31.24 | 16.24 | -0.50 | 18.54 | 1.78 | 36.23 | 10.41 | 0.87 | 11.56 | 3.25 | 4.99 | 10.08 | 1.83 | 77.63 | 0.50 |
| | 4 | 35.11 | 14.62 | -1.06 | 15.57 | 2.24 | 39.40 | 9.79 | 0.52 | 7.84 | 3.78 | 4.29 | 8.64 | 2.90 | 59.33 | 0.50 |
| | High | 42.95 | 13.00 | -1.03 | 15.57 | 3.12 | 47.09 | 9.24 | 0.58 | 8.42 | 4.83 | 4.13 | 7.02 | 3.37 | 61.80 | 0.59 |
| | Low | -1.08 | 17.09 | -0.75 | 13.92 | -0.20 | 14.46 | 8.37 | 0.46 | 11.17 | 1.44 | 15.54 | 12.87 | 1.68 | 34.04 | 1.21 |
| | 2 | 3.18 | 17.16 | -0.51 | 15.49 | 0.05 | 18.05 | 8.86 | 0.76 | 11.94 | 1.77 | 14.87 | 12.73 | 1.35 | 42.14 | 1.17 |
| 2 | 3 | 7.95 | 16.44 | 0.08 | 19.96 | 0.34 | 19.29 | 9.20 | 2.43 | 43.80 | 1.84 | 11.34 | 11.48 | 1.58 | 43.58 | 0.99 |
| | 4 | 8.51 | 15.70 | -0.60 | 15.51 | 0.39 | 19.74 | 8.48 | 0.38 | 10.17 | 2.05 | 11.23 | 11.21 | 1.53 | 46.20 | 1.00 |
| | High | 17.65 | 17.33 | 1.27 | 29.13 | 0.88 | 27.83 | 11.07 | 4.17 | 57.65 | 2.30 | 10.17 | 10.84 | 0.47 | 67.17 | 0.94 |
| | Low | 0.61 | 19.53 | -0.25 | 23.90 | -0.09 | 15.84 | 9.38 | 0.39 | 9.27 | 1.43 | 15.23 | 14.95 | 0.65 | 60.87 | 1.02 |
| | 2 | 5.17 | 17.64 | -0.36 | 15.20 | 0.16 | 15.53 | 9.22 | 0.43 | 10.67 | 1.43 | 10.36 | 12.81 | 1.24 | 41.17 | 0.81 |
| 3 | 3 | 9.20 | 16.98 | -0.51 | 14.75 | 0.40 | 18.15 | 9.20 | 0.72 | 14.41 | 1.71 | 8.96 | 12.06 | 1.61 | 40.70 | 0.74 |
| | 4 | 9.66 | 16.36 | 0.25 | 23.13 | 0.44 | 18.62 | 8.85 | 0.63 | 11.08 | 1.83 | 8.96 | 11.76 | -0.59 | 74.68 | 0.76 |
| | High | 10.41 | 16.55 | -0.55 | 15.23 | 0.49 | 20.91 | 9.27 | 0.68 | 15.39 | 2.00 | 10.50 | 11.51 | 2.02 | 44.41 | 0.91 |
| | Low | 8.33 | 18.02 | -0.56 | 13.94 | 0.33 | 15.66 | 9.65 | 0.50 | 9.76 | 1.38 | 7.32 | 12.91 | 1.54 | 39.28 | 0.57 |
| | 2 | 10.00 | 16.81 | -0.46 | 15.28 | 0.45 | 16.24 | 9.20 | 0.44 | 9.05 | 1.51 | 6.24 | 11.81 | 1.57 | 45.53 | 0.53 |
| 4 | 3 | 10.45 | 17.69 | 3.29 | 123.47 | 0.46 | 16.18 | 9.36 | 0.83 | 16.64 | 1.47 | 5.73 | 12.96 | -8.31 | 419.63 | 0.44 |
| | 4 | 12.32 | 16.86 | -0.50 | 11.14 | 0.59 | 19.02 | 9.45 | 0.20 | 7.74 | 1.76 | 6.70 | 11.68 | 1.43 | 34.17 | 0.57 |
| | High | 12.89 | 18.18 | -0.42 | 12.18 | 0.58 | 21.92 | 10.44 | 0.44 | 11.77 | 1.87 | 9.03 | 12.29 | 1.65 | 34.13 | 0.73 |
| | Low | 9.19 | 18.73 | -0.09 | 12.71 | 0.36 | 14.49 | 9.80 | 0.30 | 8.74 | 1.24 | 5.30 | 13.50 | 0.50 | 31.91 | 0.39 |
| | 2 | 10.42 | 17.78 | -0.14 | 17.56 | 0.45 | 14.58 | 9.45 | 0.44 | 9.28 | 1.29 | 4.16 | 12.80 | 0.50 | 52.78 | 0.32 |
| Big | 3 | 10.93 | 17.51 | -0.18 | 12.46 | 0.49 | 14.36 | 9.66 | 0.35 | 9.12 | 1.24 | 3.43 | 12.15 | 0.91 | 36.29 | 0.28 |
| | 4 | 12.53 | 17.81 | -0.12 | 10.29 | 0.57 | 16.46 | 10.00 | 0.33 | 9.24 | 1.41 | 3.93 | 12.13 | 0.64 | 27.69 | 0.32 |
| | High | 14.81 | 21.56 | 0.33 | 17.53 | 0.58 | 20.73 | 12.47 | 1.19 | 19.65 | 1.47 | 5.92 | 14.24 | 1.11 | 33.55 | 0.42 |

**Table 30: Summary Statistics for Equal Weighted Europe Index**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 11.99 | 13.07 | -0.27 | 7.17 | 0.73 | 18.17 | 8.20 | 0.47 | 11.76 | 1.92 | 6.18 | 8.28 | 1.08 | 20.06 | 0.75 |
| | 2 | 12.90 | 12.76 | -0.42 | 7.89 | 0.82 | 18.77 | 7.96 | 0.12 | 9.54 | 2.06 | 5.87 | 8.11 | 1.29 | 24.35 | 0.72 |
| Small | 3 | 13.91 | 12.20 | -0.41 | 7.64 | 0.94 | 18.33 | 7.83 | 0.05 | 10.36 | 2.04 | 4.42 | 7.54 | 1.32 | 26.40 | 0.59 |
| | 4 | 14.83 | 11.70 | -0.46 | 7.86 | 1.06 | 18.04 | 7.60 | 0.00 | 9.95 | 2.06 | 3.22 | 7.14 | 1.46 | 29.15 | 0.45 |
| | High | 24.19 | 11.20 | -0.35 | 7.53 | 1.95 | 24.74 | 8.01 | 0.14 | 8.50 | 2.79 | 0.55 | 6.03 | 1.57 | 37.59 | 0.09 |
| | Low | 9.26 | 16.52 | 0.44 | 14.97 | 0.42 | 16.67 | 9.66 | 1.32 | 27.19 | 1.48 | 7.41 | 11.00 | 0.51 | 25.63 | 0.67 |
| | 2 | 10.80 | 15.28 | -0.22 | 9.25 | 0.55 | 15.85 | 9.16 | 0.36 | 14.23 | 1.47 | 5.05 | 10.10 | 0.85 | 26.44 | 0.50 |
| 2 | 3 | 11.54 | 14.75 | 0.02 | 12.47 | 0.62 | 15.29 | 8.84 | -0.12 | 15.04 | 1.46 | 3.75 | 9.64 | 0.46 | 33.27 | 0.39 |
| | 4 | 13.07 | 14.35 | -0.30 | 10.44 | 0.75 | 16.25 | 8.73 | -0.15 | 10.95 | 1.59 | 3.18 | 9.29 | 0.81 | 35.56 | 0.34 |
| | High | 14.93 | 14.85 | -0.21 | 10.39 | 0.84 | 18.30 | 9.08 | 0.26 | 12.98 | 1.75 | 3.37 | 9.57 | 0.96 | 32.49 | 0.35 |
| | Low | 8.77 | 17.84 | -0.24 | 9.94 | 0.36 | 13.22 | 9.95 | -0.33 | 15.45 | 1.09 | 4.46 | 12.32 | 0.55 | 24.48 | 0.36 |
| | 2 | 9.08 | 16.85 | -0.36 | 10.91 | 0.40 | 12.98 | 9.48 | -0.45 | 14.13 | 1.12 | 3.91 | 11.61 | 0.55 | 30.00 | 0.34 |
| 3 | 3 | 11.82 | 16.39 | -0.23 | 10.12 | 0.58 | 14.21 | 9.59 | -0.18 | 12.12 | 1.23 | 2.39 | 10.81 | 0.36 | 29.16 | 0.22 |
| | 4 | 11.50 | 16.13 | -0.20 | 10.98 | 0.57 | 13.35 | 9.38 | -0.21 | 16.88 | 1.17 | 1.85 | 10.82 | 0.33 | 30.07 | 0.17 |
| | High | 13.46 | 16.79 | -0.31 | 9.15 | 0.66 | 17.15 | 9.76 | -0.15 | 13.65 | 1.51 | 3.69 | 11.31 | 0.53 | 25.34 | 0.33 |
| | Low | 13.88 | 19.02 | 0.00 | 9.42 | 0.60 | 14.75 | 11.20 | -0.02 | 12.79 | 1.10 | 0.87 | 12.70 | -0.04 | 27.09 | 0.07 |
| | 2 | 16.27 | 18.77 | 0.92 | 19.31 | 0.74 | 14.85 | 11.99 | 2.02 | 39.51 | 1.04 | -1.42 | 11.74 | -0.28 | 39.15 | -0.12 |
| 4 | 3 | 13.80 | 17.85 | 0.09 | 11.77 | 0.64 | 12.40 | 10.37 | -0.13 | 12.27 | 0.97 | -1.40 | 11.98 | -0.81 | 37.58 | -0.12 |
| | 4 | 11.59 | 17.96 | -0.04 | 12.26 | 0.51 | 13.07 | 10.21 | -0.28 | 15.82 | 1.05 | 1.48 | 12.23 | -0.11 | 31.06 | 0.12 |
| | High | 14.80 | 19.69 | -0.18 | 11.17 | 0.63 | 16.61 | 11.10 | -0.24 | 12.95 | 1.28 | 1.81 | 13.45 | -0.10 | 30.77 | 0.13 |
| | Low | 8.31 | 18.08 | 0.04 | 11.13 | 0.33 | 7.90 | 9.81 | -0.25 | 9.99 | 0.56 | -0.41 | 12.76 | -0.41 | 31.22 | -0.03 |
| | 2 | 24.23 | 20.59 | 1.49 | 20.64 | 1.06 | 18.08 | 13.97 | 3.02 | 49.46 | 1.12 | -6.14 | 11.74 | -1.23 | 40.97 | -0.52 |
| Big | 3 | 18.45 | 19.50 | 0.00 | 10.28 | 0.82 | 15.14 | 11.69 | -0.03 | 9.24 | 1.09 | -3.31 | 12.74 | -0.45 | 34.76 | -0.26 |
| | 4 | 15.09 | 20.38 | 0.11 | 11.88 | 0.62 | 12.19 | 11.73 | -0.10 | 13.30 | 0.84 | -2.90 | 13.79 | -0.81 | 36.04 | -0.21 |
| | High | 24.79 | 23.39 | 0.37 | 11.97 | 0.96 | 18.25 | 14.76 | 0.00 | 16.09 | 1.08 | -6.54 | 14.39 | -1.16 | 36.05 | -0.45 |

**Table 31: Summary Statistics for Equal Weighted North America Index**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| | Low | 25.70 | 19.09 | -0.51 | 8.91 | 1.22 | 31.01 | 11.29 | 0.07 | 7.43 | 2.54 | 5.31 | 12.43 | 1.05 | 24.58 | 0.43 |
| | 2 | 22.03 | 17.97 | -0.47 | 9.22 | 1.09 | 27.17 | 10.43 | 0.05 | 7.72 | 2.38 | 5.14 | 11.94 | 1.06 | 27.03 | 0.43 |
| Small | 3 | 23.97 | 16.30 | -0.53 | 9.22 | 1.33 | 26.79 | 9.78 | 0.07 | 8.05 | 2.50 | 2.82 | 10.52 | 1.23 | 29.43 | 0.27 |
| | 4 | 23.00 | 14.66 | -0.51 | 9.76 | 1.41 | 24.95 | 8.95 | 0.05 | 8.40 | 2.52 | 1.95 | 9.35 | 1.37 | 32.34 | 0.21 |
| | High | 31.88 | 12.70 | -0.60 | 11.86 | 2.32 | 33.42 | 8.08 | 0.13 | 9.83 | 3.84 | 1.54 | 7.83 | 1.73 | 43.95 | 0.20 |
| | Low | 9.13 | 23.83 | -0.13 | 7.92 | 0.28 | 13.33 | 12.16 | -0.22 | 7.60 | 0.90 | 4.19 | 17.19 | 0.10 | 17.90 | 0.24 |
| | 2 | 12.40 | 21.24 | -0.18 | 8.06 | 0.47 | 13.48 | 11.45 | -0.18 | 7.52 | 0.97 | 1.08 | 14.77 | 0.25 | 19.79 | 0.07 |
| 2 | 3 | 14.29 | 19.61 | -0.17 | 8.85 | 0.61 | 11.63 | 11.01 | -0.36 | 7.62 | 0.84 | -2.66 | 13.24 | 0.11 | 23.89 | -0.20 |
| | 4 | 13.92 | 18.82 | -0.24 | 10.25 | 0.61 | 10.98 | 10.55 | -0.27 | 9.30 | 0.82 | -2.94 | 12.68 | 0.20 | 26.44 | -0.23 |
| | High | 14.46 | 19.45 | -0.28 | 11.88 | 0.62 | 13.35 | 10.78 | -0.23 | 10.21 | 1.02 | -1.11 | 13.23 | 0.53 | 30.19 | -0.08 |
| | Low | 13.69 | 23.53 | -0.01 | 9.49 | 0.48 | 15.13 | 12.36 | 0.05 | 8.53 | 1.03 | 1.44 | 16.67 | -0.18 | 23.23 | 0.09 |
| | 2 | 11.92 | 20.74 | -0.05 | 10.54 | 0.46 | 11.92 | 10.96 | -0.14 | 8.81 | 0.87 | 0.01 | 14.66 | -0.22 | 26.38 | 0.00 |
| 3 | 3 | 13.15 | 18.66 | -0.20 | 9.82 | 0.58 | 11.88 | 10.33 | -0.24 | 8.64 | 0.92 | -1.27 | 12.70 | 0.18 | 26.32 | -0.10 |
| | 4 | 14.77 | 18.37 | 0.03 | 12.01 | 0.67 | 13.29 | 10.45 | 0.84 | 17.53 | 1.04 | -1.48 | 12.26 | 0.37 | 28.86 | -0.12 |
| | High | 13.91 | 18.78 | -0.36 | 12.68 | 0.61 | 13.16 | 10.42 | -0.46 | 12.74 | 1.03 | -0.75 | 12.80 | 0.53 | 33.36 | -0.06 |
| | Low | 12.93 | 23.63 | 0.20 | 13.16 | 0.45 | 13.12 | 12.08 | -0.09 | 9.43 | 0.89 | 0.20 | 17.04 | -0.69 | 32.22 | 0.01 |
| | 2 | 12.18 | 19.64 | -0.09 | 12.46 | 0.50 | 10.13 | 10.46 | -0.28 | 9.32 | 0.74 | -2.05 | 13.80 | -0.23 | 31.67 | -0.15 |
| 4 | 3 | 12.42 | 17.59 | -0.24 | 11.96 | 0.57 | 10.49 | 9.66 | -0.39 | 8.96 | 0.84 | -1.93 | 12.07 | 0.09 | 32.72 | -0.16 |
| | 4 | 12.75 | 17.31 | -0.31 | 15.73 | 0.60 | 12.06 | 9.42 | -0.39 | 10.16 | 1.03 | -0.69 | 12.03 | 0.27 | 45.67 | -0.06 |
| | High | 13.97 | 18.90 | -0.19 | 17.17 | 0.61 | 13.25 | 10.30 | -0.48 | 16.07 | 1.06 | -0.71 | 13.11 | -0.16 | 46.21 | -0.05 |
| | Low | 11.00 | 20.38 | 0.26 | 15.63 | 0.42 | 6.64 | 10.35 | -0.18 | 8.84 | 0.41 | -4.36 | 14.73 | -1.12 | 41.81 | -0.30 |
| | 2 | 11.72 | 17.94 | -0.02 | 14.09 | 0.52 | 8.08 | 9.51 | -0.23 | 8.64 | 0.60 | -3.64 | 12.63 | -0.57 | 38.94 | -0.29 |
| Big | 3 | 11.78 | 17.54 | -0.21 | 13.95 | 0.54 | 8.91 | 9.35 | -0.35 | 9.26 | 0.70 | -2.87 | 12.34 | -0.09 | 37.57 | -0.23 |
| | 4 | 12.01 | 17.28 | -0.17 | 15.56 | 0.56 | 9.17 | 9.38 | -0.43 | 10.26 | 0.72 | -2.84 | 12.03 | -0.34 | 42.97 | -0.24 |
| | High | 12.11 | 20.15 | -0.13 | 17.57 | 0.48 | 10.12 | 10.56 | -0.59 | 15.61 | 0.73 | -1.99 | 14.25 | -0.35 | 42.00 | -0.14 |

The Japan Index (refer to Table 28) shows a reduction in risk relative to return for the MA portfolio diminishing as size increases. Evidence of this can be seen in the Sharpe Ratios for the MA and TIS portfolios, with performance decreasing considerably as size increases. Unlike the previous indices, as book-to-market increases within each size category, performance declines, although this is not always consistent across quintiles.

The Asia Pacific excluding Japan Index (refer to Table 29) shows the largest reduction in risk relative to return. The most interesting observation was also observed with the value weighted index, with limited performance drop off as size increases. The same is true for book-to-market, with an increase in performance for higher levels, consistent across all size category quintiles.

The Europe Index (refer to Table 30), as with all previous indices shows the risk reducing benefits of the MA. Positive excess return performance does not persist as size increases. A positive relationship appears to exist between performance and book-to-market for each size category.

The North America Index (refer to Table 31) has the least consistent performance for the MA relative to the BH. The relationships to performance are consistent with the previous indices. However, the performance differential of the MA relative to the BH becomes negative as early as Quintile *2-3*. This is the exact same result as seen for the value weighted index.

The results are consistent with the value weighted indices with all six tables showing a clear increase in average returns for the MA portfolio relative to the BH with a reduction in the standard deviation of returns. The excess return performance varies by specific index, specifically for bigger size quintiles. The largest performance increase across all indices is 15.54%.

The summary statistics show what appears to be a significant increase in performance when using the MA, although not as robust as seen for value weighted. Section 2.4.2 will determine if this difference in performance is statistically significant.

### 2.4.2 Factor Regression Analysis

As in Section 2.3.2, regression analysis was performed using model (1), (2) and (3) from Section 1.6. Only model (3) will be shown and discussed in this section as the results do not alter nor add anything to the analysis

The following tables (Table 32-37) contain the equal weighted results when regressing the TIS excess returns using the Carhart 4-factor model. The results are tested for statistical significance at the 90%, 95% and 99% confidence, corresponding to *, ** and *** respectively.

The Developed Index in Table 32 shows a clear statistically significant excess return corresponding to a 99% confidence level for all but one of the results. The abnormal returns range from 2.619% to 11.708% per annum. The abnormal returns appear to decline as size increases although not consistently with the highest alpha corresponding to Quintile *2-Low*. Additionally, excess returns diminish as book-to-market increases but only for the smallest size groupings. As was the case with value weighted, this is caused by the BH considerably outperforming at higher levels of book-to-market for each size category, particularly for the smallest size.

**Table 32: Factor Regression Results for Equal Weighted Developed Index**

Results for the $TIS_{it}$ excess returns [0, 0, 0] corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 9.731*** | -0.458*** | -0.490*** | 0.113*** | 0.034*** | 0.513 |
| | 2 | 9.526*** | -0.447*** | -0.444*** | 0.075*** | 0.045*** | 0.517 |
| Small | 3 | 7.477*** | -0.401*** | -0.392*** | 0.020* | 0.034*** | 0.512 |
| | 4 | 6.795*** | -0.370*** | -0.359*** | -0.050*** | 0.020*** | 0.508 |
| | High | 4.140*** | -0.284*** | -0.291*** | -0.082*** | 0.009 | 0.457 |
| | Low | 11.708*** | -0.676*** | -0.549*** | 0.354*** | 0.118*** | 0.678 |
| | 2 | 9.008*** | -0.593*** | -0.445*** | 0.210*** | 0.110*** | 0.660 |
| 2 | 3 | 7.264*** | -0.560*** | -0.390*** | 0.033*** | 0.082*** | 0.656 |
| | 4 | 6.787*** | -0.537*** | -0.358*** | -0.100*** | 0.065*** | 0.650 |
| | High | 7.584*** | -0.537*** | -0.406*** | -0.232*** | 0.056*** | 0.650 |
| | Low | 8.502*** | -0.683*** | -0.423*** | 0.460*** | 0.167*** | 0.672 |
| | 2 | 8.152*** | -0.646*** | -0.354*** | 0.215*** | 0.110*** | 0.675 |
| 3 | 3 | 6.074*** | -0.589*** | -0.272*** | 0.004 | 0.114*** | 0.659 |
| | 4 | 6.944*** | -0.581*** | -0.256*** | -0.133*** | 0.081*** | 0.665 |
| | High | 7.626*** | -0.586*** | -0.294*** | -0.274*** | 0.069*** | 0.665 |
| | Low | 6.763*** | -0.660*** | -0.246*** | 0.435*** | 0.160*** | 0.660 |
| | 2 | 5.118*** | -0.581*** | -0.166*** | 0.164*** | 0.102*** | 0.623 |
| 4 | 3 | 6.276*** | -0.593*** | -0.163*** | -0.048*** | 0.078*** | 0.661 |
| | 4 | 6.620*** | -0.582*** | -0.161*** | -0.194*** | 0.057*** | 0.654 |
| | High | 7.645*** | -0.619*** | -0.155*** | -0.304*** | 0.080*** | 0.662 |
| | Low | 3.347*** | -0.590*** | -0.003 | 0.508*** | 0.177*** | 0.689 |
| | 2 | 2.619** | -0.553*** | 0.036*** | 0.025* | 0.037*** | 0.632 |
| Big | 3 | 4.283*** | -0.564*** | 0.024* | -0.106*** | 0.066*** | 0.662 |
| | 4 | 4.920*** | -0.590*** | 0.047*** | -0.200*** | 0.071*** | 0.664 |
| | High | 3.736*** | -0.604*** | 0.057*** | -0.268*** | 0.112*** | 0.631 |

The Developed excluding US Index in Table 33 also shows a clear statistically significant excess return with only two results in size category *Big* not statistically significant at even 90% confidence. The abnormal returns range from 2.159% to 11.440% per annum. As was the case for the Developed Index, the abnormal returns decline as size increases although not consistently with the highest alpha corresponding to Quintile *2-Low*. The same relationship also exists for performance and book-to-market.

**Table 33: Factor Regression Results for Equal Weighted Developed excl. US Index**

Results for the $TIS_{it}$ excess returns [0, 0, 0] corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 7.670*** | -0.450*** | -0.408*** | 0.211*** | 0.067*** | 0.549 |
| | 2 | 7.697*** | -0.449*** | -0.397*** | 0.157*** | 0.068*** | 0.548 |
| Small | 3 | 6.268*** | -0.417*** | -0.370*** | 0.082*** | 0.054*** | 0.529 |
| | 4 | 5.319*** | -0.380*** | -0.341*** | 0.030*** | 0.038*** | 0.522 |
| | High | 2.837*** | -0.313*** | -0.310*** | -0.009 | 0.025*** | 0.498 |
| | Low | 11.440*** | -0.642*** | -0.528*** | 0.397*** | 0.147*** | 0.660 |
| | 2 | 8.657*** | -0.586*** | -0.473*** | 0.219*** | 0.131*** | 0.641 |
| 2 | 3 | 7.283*** | -0.554*** | -0.454*** | 0.049*** | 0.088*** | 0.633 |
| | 4 | 6.958*** | -0.531*** | -0.457*** | -0.044*** | 0.078*** | 0.631 |
| | High | 6.881*** | -0.545*** | -0.501*** | -0.141*** | 0.063*** | 0.623 |
| | Low | 8.270*** | -0.637*** | -0.387*** | 0.399*** | 0.134*** | 0.655 |
| | 2 | 7.854*** | -0.611*** | -0.376*** | 0.133*** | 0.130*** | 0.662 |
| 3 | 3 | 5.490*** | -0.582*** | -0.360*** | 0.045*** | 0.118*** | 0.621 |
| | 4 | 6.016*** | -0.568*** | -0.356*** | -0.070*** | 0.091*** | 0.630 |
| | High | 7.081*** | -0.580*** | -0.372*** | -0.172*** | 0.079*** | 0.640 |
| | Low | 6.550*** | -0.626*** | -0.236*** | 0.347*** | 0.139*** | 0.655 |
| | 2 | 4.667*** | -0.593*** | -0.250*** | 0.114*** | 0.119*** | 0.644 |
| 4 | 3 | 4.411*** | -0.572*** | -0.226*** | -0.050*** | 0.110*** | 0.636 |
| | 4 | 4.781*** | -0.577*** | -0.232*** | -0.079*** | 0.087*** | 0.645 |
| | High | 7.716*** | -0.621*** | -0.244*** | -0.220*** | 0.089*** | 0.656 |
| | Low | 2.710** | -0.565*** | -0.038*** | 0.447*** | 0.156*** | 0.676 |
| | 2 | -0.263 | -0.487*** | 0.015 | 0.060*** | 0.050*** | 0.577 |
| Big | 3 | 2.159* | -0.548*** | 0.012 | 0.010 | 0.117*** | 0.663 |
| | 4 | 2.872** | -0.558*** | 0.057*** | -0.107*** | 0.112*** | 0.655 |
| | High | -0.108 | -0.535*** | 0.099*** | -0.196*** | 0.125*** | 0.577 |

The Japan Index in Table 34 shows the most inconsistent results across all the indices, with large statistically significant negative excess returns for Quintile *B-2* to *B-High*. The abnormal returns range from -4.161% to 12.580% per annum. As with previous results size and performance are negatively related. For each of the smallest size categories performance and book-to-market are negatively related as seen in previous results.

**Table 34: Factor Regression Results for Equal Weighted Japan Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 12.580*** | -0.557*** | -0.696*** | 0.089*** | 0.093*** | 0.605 |
| | 2 | 9.999*** | -0.486*** | -0.596*** | 0.014 | 0.071*** | 0.601 |
| Small | 3 | 9.161*** | -0.456*** | -0.549*** | -0.038*** | 0.070*** | 0.605 |
| | 4 | 8.220*** | -0.446*** | -0.523*** | -0.055*** | 0.062*** | 0.610 |
| | High | 7.832*** | -0.420*** | -0.487*** | -0.128*** | 0.053*** | 0.622 |
| | Low | 10.788*** | -0.642*** | -0.643*** | 0.269*** | 0.098*** | 0.658 |
| | 2 | 8.294*** | -0.590*** | -0.554*** | 0.093*** | 0.120*** | 0.674 |
| 2 | 3 | 6.186*** | -0.572*** | -0.520*** | -0.043*** | 0.102*** | 0.677 |
| | 4 | 4.647*** | -0.552*** | -0.483*** | -0.070*** | 0.108*** | 0.668 |
| | High | 5.221*** | -0.578*** | -0.500*** | -0.207*** | 0.072*** | 0.691 |
| | Low | 9.890*** | -0.643*** | -0.527*** | 0.310*** | 0.100*** | 0.661 |
| | 2 | 3.099* | -0.610*** | -0.399*** | 0.141*** | 0.117*** | 0.671 |
| 3 | 3 | 3.464** | -0.596*** | -0.402*** | -0.002 | 0.145*** | 0.674 |
| | 4 | 1.321 | -0.576*** | -0.394*** | -0.131*** | 0.098*** | 0.662 |
| | High | 1.808 | -0.584*** | -0.384*** | -0.227*** | 0.067*** | 0.671 |
| | Low | 5.664*** | -0.632*** | -0.312*** | 0.318*** | 0.078*** | 0.674 |
| | 2 | -1.150 | -0.584*** | -0.228*** | 0.107*** | 0.125*** | 0.655 |
| 4 | 3 | -1.471 | -0.575*** | -0.209*** | -0.048*** | 0.106*** | 0.665 |
| | 4 | -1.319 | -0.567*** | -0.223*** | -0.142*** | 0.087*** | 0.662 |
| | High | -0.481 | -0.593*** | -0.241*** | -0.253*** | 0.101*** | 0.660 |
| | Low | -0.962 | -0.597*** | -0.029** | 0.362*** | 0.097*** | 0.696 |
| | 2 | -4.161*** | -0.557*** | -0.027*** | 0.098*** | 0.097*** | 0.687 |
| Big | 3 | -3.529** | -0.568*** | -0.029*** | -0.040*** | 0.119*** | 0.681 |
| | 4 | -3.340** | -0.569*** | -0.042*** | -0.154*** | 0.052*** | 0.672 |
| | High | -3.078* | -0.635*** | -0.057*** | -0.288*** | 0.091*** | 0.643 |

The Asia Pacific excluding Japan Index has the highest performance relative to the other indices. All alphas are statistically significant at 99% confidence, with abnormal returns ranging from 5.728% to 17.478% per annum. Interestingly, the highest excess returns appear in size category *2* and *3*, contradicting the until now consistent relationship between size and performance. However, for smallest size categories performance and book-to-market are negatively related as seen in previous results.

**Table 35: Factor Regression Results for Equal Weighted Asia Pacific excl. Japan Index**

Results for the $TIS_{it}$ excess returns [0, 0, 0] corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 6.967*** | -0.510*** | -0.445*** | 0.175*** | -0.025*** | 0.469 |
| | 2 | 8.560*** | -0.506*** | -0.420*** | 0.162*** | 0.008 | 0.503 |
| Small | 3 | 6.533*** | -0.481*** | -0.381*** | 0.129*** | -0.013 | 0.494 |
| | 4 | 5.728*** | -0.425*** | -0.348*** | 0.094*** | -0.009 | 0.513 |
| | High | 5.760*** | -0.358*** | -0.311*** | 0.014* | -0.010* | 0.515 |
| | Low | 17.478*** | -0.687*** | -0.582*** | 0.163*** | 0.008 | 0.603 |
| | 2 | 16.717*** | -0.691*** | -0.561*** | 0.131*** | 0.049*** | 0.611 |
| 2 | 3 | 13.679*** | -0.630*** | -0.512*** | 0.063*** | 0.021*** | 0.608 |
| | 4 | 14.791*** | -0.629*** | -0.474*** | -0.029*** | -0.021*** | 0.623 |
| | High | 14.394*** | -0.593*** | -0.487*** | -0.193*** | -0.004 | 0.567 |
| | Low | 17.011*** | -0.767*** | -0.523*** | 0.281*** | 0.024** | 0.601 |
| | 2 | 12.593*** | -0.674*** | -0.464*** | 0.164*** | 0.012 | 0.601 |
| 3 | 3 | 11.755*** | -0.642*** | -0.384*** | 0.116*** | -0.004 | 0.617 |
| | 4 | 11.785*** | -0.605*** | -0.398*** | -0.025** | 0.056*** | 0.532 |
| | High | 15.028*** | -0.619*** | -0.394*** | -0.200*** | 0.024*** | 0.571 |
| | Low | 9.573*** | -0.655*** | -0.320*** | 0.209*** | 0.017* | 0.609 |
| | 2 | 8.406*** | -0.583*** | -0.227*** | 0.171*** | 0.031*** | 0.593 |
| 4 | 3 | 8.241*** | -0.593*** | -0.191*** | 0.181*** | 0.012 | 0.526 |
| | 4 | 9.615*** | -0.607*** | -0.259*** | 0.056*** | 0.043*** | 0.609 |
| | High | 13.669*** | -0.626*** | -0.222*** | -0.154*** | 0.049*** | 0.577 |
| | Low | 8.069*** | -0.641*** | -0.038*** | 0.257*** | 0.026*** | 0.662 |
| | 2 | 6.801*** | -0.597*** | -0.010 | 0.232*** | 0.032*** | 0.651 |
| Big | 3 | 6.254*** | -0.603*** | -0.094*** | 0.111*** | 0.071*** | 0.650 |
| | 4 | 8.638*** | -0.600*** | -0.026** | -0.059*** | 0.029*** | 0.654 |
| | High | 12.839*** | -0.657*** | 0.024 | -0.301*** | 0.043*** | 0.602 |

The Europe Index is similar to the Japan Index with inconsistent results for the biggest size categories and two negative excess return statistically significant results for Quintile *B-2* and *B-High*. The abnormal returns range from -4.236% to 7.940% per annum. Consistent with the MA, size and performance are negatively related and for smallest size categories performance and book-to-market are negatively related.

**Table 36: Factor Regression Results for Equal Weighted Europe Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 7.118*** | -0.442*** | -0.452*** | 0.228*** | 0.064*** | 0.550 |
| | 2 | 6.818*** | -0.443*** | -0.439*** | 0.182*** | 0.081*** | 0.584 |
| Small | 3 | 5.657*** | -0.409*** | -0.404*** | 0.109*** | 0.060*** | 0.565 |
| | 4 | 4.725*** | -0.386*** | -0.383*** | 0.044*** | 0.044*** | 0.557 |
| | High | 2.024** | -0.308*** | -0.315*** | -0.010 | 0.024*** | 0.495 |
| | Low | 7.940*** | -0.590*** | -0.470*** | 0.374*** | 0.143*** | 0.629 |
| | 2 | 6.321*** | -0.546*** | -0.456*** | 0.205*** | 0.104*** | 0.603 |
| 2 | 3 | 5.830*** | -0.523*** | -0.432*** | 0.032*** | 0.073*** | 0.604 |
| | 4 | 5.528*** | -0.500*** | -0.414*** | -0.060*** | 0.067*** | 0.606 |
| | High | 6.127*** | -0.509*** | -0.400*** | -0.155*** | 0.066*** | 0.625 |
| | Low | 5.296*** | -0.639*** | -0.397*** | 0.383*** | 0.146*** | 0.630 |
| | 2 | 5.671*** | -0.619*** | -0.397*** | 0.141*** | 0.129*** | 0.648 |
| 3 | 3 | 4.755*** | -0.562*** | -0.363*** | -0.046*** | 0.103*** | 0.626 |
| | 4 | 4.554*** | -0.571*** | -0.380*** | -0.082*** | 0.086*** | 0.635 |
| | High | 7.039*** | -0.575*** | -0.359*** | -0.239*** | 0.082*** | 0.638 |
| | Low | 0.936 | -0.590*** | -0.234*** | 0.395*** | 0.203*** | 0.609 |
| | 2 | 0.222 | -0.543*** | -0.212*** | 0.134*** | 0.110*** | 0.557 |
| 4 | 3 | 0.749 | -0.569*** | -0.215*** | 0.001 | 0.124*** | 0.614 |
| | 4 | 3.979*** | -0.589*** | -0.235*** | -0.083*** | 0.131*** | 0.637 |
| | High | 5.219*** | -0.621*** | -0.230*** | -0.278*** | 0.131*** | 0.632 |
| | Low | -0.279 | -0.539*** | 0.050*** | 0.463*** | 0.161*** | 0.680 |
| | 2 | -3.735*** | -0.479*** | 0.036*** | 0.041*** | 0.044*** | 0.570 |
| Big | 3 | -1.453 | -0.530*** | 0.044*** | 0.019 | 0.143*** | 0.650 |
| | 4 | -0.358 | -0.582*** | 0.018 | -0.111*** | 0.153*** | 0.663 |
| | High | -4.236** | -0.545*** | 0.023 | -0.140*** | 0.165*** | 0.556 |

The North America Index is similar to the Japan and Europe Indices with inconsistent results for the biggest size categories although it does not contain any statistically significant negative results. The abnormal returns range from 2.374% to 9.236% per annum. Consistent with the MA results seen previously, size and performance are negatively related and for the smallest size categories performance and book-to-market are negatively related.

**Table 37: Factor Regression Results for Equal Weighted North America Index**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held.

| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Low | 9.236*** | -0.489*** | -0.438*** | 0.076*** | 0.047*** | 0.559 |
| | 2 | 8.916*** | -0.487*** | -0.394*** | 0.055*** | 0.068*** | 0.580 |
| Small | 3 | 6.542*** | -0.442*** | -0.346*** | -0.030*** | 0.044*** | 0.582 |
| | 4 | 5.667*** | -0.403*** | -0.315*** | -0.118*** | 0.025*** | 0.591 |
| | High | 4.740*** | -0.326*** | -0.237*** | -0.185*** | 0.020*** | 0.543 |
| | Low | 8.427*** | -0.698*** | -0.577*** | 0.418*** | 0.155*** | 0.690 |
| | 2 | 5.481*** | -0.638*** | -0.467*** | 0.210*** | 0.116*** | 0.681 |
| 2 | 3 | 2.090 | -0.610*** | -0.400*** | -0.035*** | 0.106*** | 0.687 |
| | 4 | 2.374* | -0.602*** | -0.379*** | -0.206*** | 0.069*** | 0.693 |
| | High | 4.774*** | -0.625*** | -0.394*** | -0.378*** | 0.073*** | 0.696 |
| | Low | 5.222*** | -0.680*** | -0.425*** | 0.435*** | 0.176*** | 0.672 |
| | 2 | 4.365*** | -0.650*** | -0.339*** | 0.199*** | 0.127*** | 0.676 |
| 3 | 3 | 3.167** | -0.592*** | -0.279*** | -0.011 | 0.109*** | 0.679 |
| | 4 | 3.660*** | -0.591*** | -0.237*** | -0.214*** | 0.069*** | 0.680 |
| | High | 4.909*** | -0.618*** | -0.242*** | -0.349*** | 0.071*** | 0.690 |
| | Low | 3.428* | -0.688*** | -0.239*** | 0.508*** | 0.220*** | 0.657 |
| | 2 | 2.036 | -0.629*** | -0.145*** | 0.174*** | 0.128*** | 0.674 |
| 4 | 3 | 2.795** | -0.584*** | -0.107*** | -0.081*** | 0.065*** | 0.674 |
| | 4 | 4.324*** | -0.578*** | -0.072*** | -0.225*** | 0.059*** | 0.655 |
| | High | 4.841*** | -0.628*** | -0.119*** | -0.365*** | 0.091*** | 0.676 |
| | Low | -1.734 | -0.618*** | 0.031*** | 0.458*** | 0.210*** | 0.691 |
| | 2 | 0.673 | -0.613*** | 0.055*** | 0.059*** | 0.094*** | 0.706 |
| Big | 3 | 1.926 | -0.610*** | 0.057*** | -0.081*** | 0.068*** | 0.698 |
| | 4 | 2.179* | -0.587*** | 0.080*** | -0.230*** | 0.055*** | 0.678 |
| | High | 3.654** | -0.688*** | 0.038*** | -0.345*** | 0.127*** | 0.695 |

The results above show the MA has the ability to significantly outperform the BH for the lowest size quintiles irrespective of the country index. The results for each quintile as size increases becomes less certain, with country index playing a far greater role in the potential return. The results overall continue to support the MA as a superior strategy to the BH.

### 2.4.3 Market Timing

As in Section 2.3.3, regression analysis was performed using model (4) and (5) from Section 1.6 to determine if market timing played a role in the MA outperforming the BH as per the results in Section 2.3.2. The results can be seen in Table 38 to 43.

The results are very similar to value weighted, with the Developed including and excluding US Indices showing a positive statistically significant result for $\beta_{i,m^2}$ and $\gamma_{i,m}$ for the smaller quintiles. The results indicate there is more of an ability to time the market when excluding US for slightly bigger quintiles.

The results for the Japan Index indicate very little evidence in favour of market timing ability when using the MA. Given the index had the worst performance for the MA relative to the BH the result here is not surprising.

In contrast, the Asia Pacific excluding Japan Index provides the strongest evidence in favour of market timing, with statistically significant results at 99% confidence level for all but a single quintile, Quintile *3-4* for model (4). This result supports the results from Section 2.4.2 which reported the highest excess return performance, with an alpha of 17.478% per annum.

The results for the Europe and North America Indices are similar to the Japan Index, with positive statistically significant results for $\beta_{i,m^2}$ and $\gamma_{i,m}$ in only the smallest quintile portfolios with inconsistent results otherwise.

**Table 38: Market Timing Results for Equal Weighted Developed Index**

Equal Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 7.261*** | -0.345*** | 0.013*** | 0.386 | 0.865 | -0.285*** | 0.119*** | 0.388 |
| | 2 | 7.040*** | -0.346*** | 0.013*** | 0.411 | 0.322 | -0.283*** | 0.123*** | 0.414 |
| Small | 3 | 5.423*** | -0.310*** | 0.010*** | 0.411 | -0.018 | -0.260*** | 0.097*** | 0.414 |
| | 4 | 4.134*** | -0.281*** | 0.011*** | 0.408 | -0.968 | -0.233*** | 0.097*** | 0.409 |
| | High | 1.563* | -0.209*** | 0.010*** | 0.350 | -2.390** | -0.169*** | 0.079*** | 0.351 |
| | Low | 11.751*** | -0.571*** | 0.007*** | 0.561 | 6.823*** | -0.528*** | 0.085*** | 0.561 |
| | 2 | 7.971*** | -0.507*** | 0.011*** | 0.575 | 3.487* | -0.463*** | 0.087*** | 0.575 |
| 2 | 3 | 6.218*** | -0.477*** | 0.007*** | 0.592 | 2.967* | -0.446*** | 0.060*** | 0.592 |
| | 4 | 4.961*** | -0.454*** | 0.008*** | 0.588 | 1.594 | -0.422*** | 0.064*** | 0.589 |
| | High | 5.059*** | -0.435*** | 0.008*** | 0.551 | 2.124 | -0.406*** | 0.059*** | 0.551 |
| | Low | 10.462*** | -0.621*** | 0.002 | 0.577 | 8.297*** | -0.604*** | 0.035* | 0.577 |
| | 2 | 8.123*** | -0.583*** | 0.006*** | 0.624 | 5.352*** | -0.556*** | 0.053*** | 0.624 |
| 3 | 3 | 5.584*** | -0.538*** | 0.005*** | 0.628 | 3.131* | -0.515*** | 0.046*** | 0.628 |
| | 4 | 5.952*** | -0.524*** | 0.004** | 0.631 | 3.791** | -0.505*** | 0.039*** | 0.631 |
| | High | 5.283*** | -0.512*** | 0.007*** | 0.603 | 2.514 | -0.484*** | 0.056*** | 0.603 |
| | Low | 9.665*** | -0.641*** | -0.002 | 0.599 | 8.464*** | -0.635*** | 0.011 | 0.599 |
| | 2 | 6.502*** | -0.562*** | -0.001 | 0.603 | 5.475*** | -0.556*** | 0.011 | 0.603 |
| 4 | 3 | 6.407*** | -0.562*** | 0.000 | 0.647 | 4.769*** | -0.550*** | 0.023 | 0.647 |
| | 4 | 5.929*** | -0.543*** | 0.001 | 0.629 | 3.860** | -0.527*** | 0.030** | 0.629 |
| | High | 7.015*** | -0.581*** | -0.001 | 0.619 | 4.915*** | -0.567*** | 0.026* | 0.620 |
| | Low | 7.998*** | -0.635*** | -0.007*** | 0.621 | 7.731*** | -0.642*** | -0.015 | 0.620 |
| | 2 | 4.154*** | -0.569*** | -0.006*** | 0.631 | 3.544** | -0.572*** | -0.007 | 0.631 |
| Big | 3 | 5.112*** | -0.576*** | -0.004** | 0.652 | 3.872** | -0.572*** | 0.007 | 0.652 |
| | 4 | 6.177*** | -0.606*** | -0.007*** | 0.643 | 5.454*** | -0.609*** | -0.009 | 0.643 |
| | High | 5.300*** | -0.626*** | -0.009*** | 0.596 | 6.601*** | -0.645*** | -0.039** | 0.595 |

**Table 39: Market Timing Results for Equal Weighted Developed excluding US. Index**

Equal Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 5.157*** | -0.319*** | 0.015*** | 0.414 | -0.706 | -0.265*** | 0.109*** | 0.414 |
| | 2 | 4.738*** | -0.322*** | 0.016*** | 0.430 | -1.386 | -0.265*** | 0.115*** | 0.430 |
| Small | 3 | 3.344*** | -0.295*** | 0.014*** | 0.420 | -1.980 | -0.246*** | 0.100*** | 0.419 |
| | 4 | 2.413** | -0.265*** | 0.012*** | 0.414 | -2.272 | -0.222*** | 0.088*** | 0.413 |
| | High | 0.193 | -0.207*** | 0.010*** | 0.367 | -2.863** | -0.176*** | 0.063*** | 0.365 |
| | Low | 10.909*** | -0.486*** | 0.012*** | 0.511 | 5.141** | -0.436*** | 0.100*** | 0.511 |
| | 2 | 6.806*** | -0.442*** | 0.014*** | 0.524 | 1.383 | -0.392*** | 0.101*** | 0.523 |
| 2 | 3 | 4.152*** | -0.407*** | 0.015*** | 0.526 | -1.455 | -0.355*** | 0.105*** | 0.526 |
| | 4 | 3.471*** | -0.381*** | 0.014*** | 0.514 | -1.020 | -0.336*** | 0.090*** | 0.513 |
| | High | 3.659*** | -0.376*** | 0.010*** | 0.480 | 0.984 | -0.347*** | 0.059*** | 0.479 |
| | Low | 8.469*** | -0.528*** | 0.009*** | 0.561 | 3.673* | -0.487*** | 0.081*** | 0.561 |
| | 2 | 5.433*** | -0.499*** | 0.015*** | 0.599 | -0.058 | -0.447*** | 0.105*** | 0.599 |
| 3 | 3 | 4.833*** | -0.474*** | 0.005*** | 0.563 | 1.937 | -0.449*** | 0.049*** | 0.563 |
| | 4 | 3.758*** | -0.455*** | 0.009*** | 0.571 | 0.556 | -0.424*** | 0.062*** | 0.571 |
| | High | 4.316*** | -0.457*** | 0.009*** | 0.572 | 1.466 | -0.429*** | 0.057*** | 0.571 |
| | Low | 7.396*** | -0.569*** | 0.006*** | 0.607 | 3.687* | -0.538*** | 0.061*** | 0.607 |
| | 2 | 4.323*** | -0.523*** | 0.006*** | 0.613 | 1.286 | -0.497*** | 0.052*** | 0.613 |
| 4 | 3 | 3.751*** | -0.507*** | 0.004** | 0.611 | 1.318 | -0.487*** | 0.040*** | 0.612 |
| | 4 | 3.919*** | -0.506*** | 0.004** | 0.620 | 1.418 | -0.487*** | 0.039*** | 0.620 |
| | High | 6.410*** | -0.544*** | 0.003 | 0.622 | 4.065** | -0.526*** | 0.035** | 0.622 |
| | Low | 6.627*** | -0.582*** | -0.003 | 0.626 | 5.238*** | -0.577*** | 0.008 | 0.626 |
| | 2 | 1.554 | -0.501*** | -0.005*** | 0.575 | 1.599 | -0.507*** | -0.014 | 0.574 |
| Big | 3 | 3.097** | -0.568*** | 0.000 | 0.653 | 0.462 | -0.552*** | 0.031** | 0.653 |
| | 4 | 4.029*** | -0.591*** | -0.003 | 0.640 | 2.479 | -0.585*** | 0.010 | 0.640 |
| | High | 1.468 | -0.583*** | -0.006*** | 0.551 | 1.712 | -0.592*** | -0.019 | 0.550 |

**Table 40: Market Timing Results for Equal Weighted Japan Index**

Equal Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 13.255*** | -0.426*** | -0.001 | 0.397 | 8.691** | -0.410*** | 0.033 | 0.397 |
| | 2 | 9.541*** | -0.370*** | 0.001 | 0.403 | 5.235* | -0.351*** | 0.038** | 0.404 |
| Small | 3 | 9.405*** | -0.346*** | -0.001 | 0.413 | 5.616** | -0.333*** | 0.027* | 0.414 |
| | 4 | 9.567*** | -0.339*** | -0.004*** | 0.426 | 6.185** | -0.333*** | 0.014 | 0.425 |
| | High | 9.670*** | -0.315*** | -0.005*** | 0.437 | 7.850*** | -0.319*** | -0.005 | 0.435 |
| | Low | 11.963*** | -0.533*** | -0.001 | 0.490 | 6.844** | -0.513*** | 0.040** | 0.490 |
| | 2 | 9.899*** | -0.490*** | -0.003* | 0.536 | 6.674** | -0.483*** | 0.015 | 0.536 |
| 2 | 3 | 8.618*** | -0.469*** | -0.006*** | 0.552 | 7.934*** | -0.478*** | -0.017 | 0.551 |
| | 4 | 6.495*** | -0.456*** | -0.005*** | 0.552 | 6.218** | -0.465*** | -0.016 | 0.551 |
| | High | 7.855*** | -0.468*** | -0.008*** | 0.570 | 9.293*** | -0.489*** | -0.041*** | 0.568 |
| | Low | 10.597*** | -0.560*** | 0.001 | 0.534 | 6.154* | -0.541*** | 0.040** | 0.534 |
| | 2 | 5.109** | -0.545*** | -0.003** | 0.597 | 4.415 | -0.548*** | -0.007 | 0.597 |
| 3 | 3 | 6.537*** | -0.523*** | -0.007*** | 0.601 | 7.518*** | -0.541*** | -0.034** | 0.600 |
| | 4 | 3.584* | -0.493*** | -0.006*** | 0.590 | 6.080** | -0.516*** | -0.044*** | 0.589 |
| | High | 3.473* | -0.496*** | -0.006*** | 0.598 | 5.824** | -0.517*** | -0.041*** | 0.597 |
| | Low | 9.573*** | -0.591*** | -0.006*** | 0.610 | 8.094*** | -0.597*** | -0.010 | 0.609 |
| | 2 | 1.956 | -0.551*** | -0.006*** | 0.625 | 3.955 | -0.571*** | -0.038*** | 0.625 |
| 4 | 3 | 1.030 | -0.536*** | -0.006*** | 0.642 | 3.653 | -0.559*** | -0.044*** | 0.641 |
| | 4 | 0.626 | -0.519*** | -0.006*** | 0.633 | 3.150 | -0.540*** | -0.041*** | 0.632 |
| | High | 2.283 | -0.535*** | -0.008*** | 0.618 | 5.952** | -0.567*** | -0.061*** | 0.617 |
| | Low | 3.843** | -0.618*** | -0.007*** | 0.664 | 6.139** | -0.642*** | -0.046*** | 0.663 |
| | 2 | -0.599 | -0.563*** | -0.007*** | 0.680 | 2.596 | -0.590*** | -0.052*** | 0.680 |
| Big | 3 | 0.647 | -0.567*** | -0.009*** | 0.673 | 3.030 | -0.596*** | -0.055*** | 0.671 |
| | 4 | -0.970 | -0.554*** | -0.006*** | 0.663 | 1.478 | -0.577*** | -0.044*** | 0.662 |
| | High | 1.358 | -0.611*** | -0.012*** | 0.619 | 6.355** | -0.656*** | -0.086*** | 0.617 |

**Table 41: Market Timing Results for Equal Weighted Asia Pacific excluding Japan Index**

Equal Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 0.877 | -0.378*** | 0.028*** | 0.359 | -10.804*** | -0.274*** | 0.217*** | 0.351 |
| | 2 | 3.777** | -0.383*** | 0.024*** | 0.397 | -6.932*** | -0.289*** | 0.194*** | 0.391 |
| Small | 3 | 1.673 | -0.367*** | 0.022*** | 0.400 | -8.722*** | -0.277*** | 0.186*** | 0.396 |
| | 4 | 0.028 | -0.319*** | 0.024*** | 0.423 | -10.896*** | -0.223*** | 0.198*** | 0.415 |
| | High | 0.213 | -0.258*** | 0.021*** | 0.426 | -9.136*** | -0.175*** | 0.171*** | 0.415 |
| | Low | 11.018*** | -0.513*** | 0.031*** | 0.477 | -4.645* | -0.381*** | 0.271*** | 0.474 |
| | 2 | 10.115*** | -0.521*** | 0.032*** | 0.503 | -4.301* | -0.395*** | 0.260*** | 0.497 |
| 2 | 3 | 6.893*** | -0.471*** | 0.029*** | 0.507 | -7.555*** | -0.348*** | 0.253*** | 0.502 |
| | 4 | 7.242*** | -0.474*** | 0.028*** | 0.537 | -7.740*** | -0.350*** | 0.254*** | 0.534 |
| | High | 5.128*** | -0.424*** | 0.030*** | 0.470 | -10.805*** | -0.291*** | 0.272*** | 0.466 |
| | Low | 11.763*** | -0.619*** | 0.030*** | 0.503 | -3.411 | -0.491*** | 0.263*** | 0.500 |
| | 2 | 7.702*** | -0.537*** | 0.025*** | 0.514 | -3.248 | -0.440*** | 0.199*** | 0.510 |
| 3 | 3 | 6.939*** | -0.527*** | 0.022*** | 0.554 | -4.851** | -0.429*** | 0.200*** | 0.553 |
| | 4 | 5.383*** | -0.475*** | 0.026*** | 0.486 | -5.551** | -0.377*** | 0.204*** | 0.480 |
| | High | 6.251*** | -0.478*** | 0.029*** | 0.518 | -8.251*** | -0.355*** | 0.252*** | 0.514 |
| | Low | 4.793*** | -0.565*** | 0.025*** | 0.559 | -8.242*** | -0.456*** | 0.223*** | 0.557 |
| | 2 | 4.305** | -0.520*** | 0.022*** | 0.563 | -6.502*** | -0.428*** | 0.188*** | 0.560 |
| 4 | 3 | 10.828*** | -0.549*** | -0.003 | 0.495 | 3.194 | -0.508*** | 0.076*** | 0.496 |
| | 4 | 4.841*** | -0.526*** | 0.022*** | 0.589 | -5.728*** | -0.436*** | 0.185*** | 0.586 |
| | High | 7.447*** | -0.542*** | 0.021*** | 0.562 | -3.963* | -0.448*** | 0.193*** | 0.561 |
| | Low | 7.932*** | -0.644*** | 0.009*** | 0.636 | 2.318 | -0.600*** | 0.090*** | 0.636 |
| | 2 | 5.940*** | -0.606*** | 0.011*** | 0.629 | -1.011 | -0.551*** | 0.111*** | 0.630 |
| Big | 3 | 4.686*** | -0.579*** | 0.012*** | 0.640 | -1.904 | -0.525*** | 0.110*** | 0.640 |
| | 4 | 6.111*** | -0.586*** | 0.009*** | 0.653 | 0.997 | -0.545*** | 0.084*** | 0.653 |
| | High | 7.665*** | -0.641*** | 0.012*** | 0.570 | -1.088 | -0.574*** | 0.134*** | 0.571 |

**Table 42: Market Timing Results for Equal Weighted Europe Index**

Equal Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 6.705*** | -0.284*** | 0.004*** | 0.375 | 2.653 | -0.257*** | 0.054*** | 0.376 |
| | 2 | 5.787*** | -0.295*** | 0.006*** | 0.423 | 0.583 | -0.258*** | 0.073*** | 0.424 |
| Small | 3 | 4.873*** | -0.273*** | 0.004*** | 0.418 | -0.267 | -0.240*** | 0.066*** | 0.420 |
| | 4 | 3.323*** | -0.258*** | 0.005*** | 0.416 | -1.505 | -0.225*** | 0.065*** | 0.418 |
| | High | 0.898 | -0.203*** | 0.003*** | 0.361 | -2.206* | -0.182*** | 0.041*** | 0.362 |
| | Low | 10.021*** | -0.434*** | 0.000 | 0.491 | 5.610** | -0.410*** | 0.046*** | 0.492 |
| | 2 | 6.969*** | -0.396*** | 0.002 | 0.487 | 3.745* | -0.376*** | 0.039*** | 0.487 |
| 2 | 3 | 5.776*** | -0.385*** | 0.001 | 0.505 | 1.687 | -0.361*** | 0.046*** | 0.505 |
| | 4 | 4.814*** | -0.370*** | 0.002 | 0.504 | 0.738 | -0.346*** | 0.049*** | 0.505 |
| | High | 4.944*** | -0.389*** | 0.003** | 0.524 | 1.041 | -0.364*** | 0.049*** | 0.524 |
| | Low | 8.124*** | -0.508*** | -0.002 | 0.539 | 5.273** | -0.496*** | 0.024 | 0.539 |
| | 2 | 7.244*** | -0.498*** | -0.001 | 0.581 | 4.114** | -0.482*** | 0.030** | 0.581 |
| 3 | 3 | 5.769*** | -0.457*** | -0.002 | 0.565 | 3.577* | -0.448*** | 0.017 | 0.565 |
| | 4 | 5.348*** | -0.459*** | -0.002 | 0.568 | 3.245* | -0.451*** | 0.015 | 0.568 |
| | High | 6.295*** | -0.477*** | 0.001 | 0.562 | 3.262 | -0.459*** | 0.035** | 0.562 |
| | Low | 6.487*** | -0.526*** | -0.007*** | 0.543 | 6.981*** | -0.541*** | -0.029* | 0.542 |
| | 2 | 3.121* | -0.482*** | -0.005*** | 0.533 | 2.588 | -0.487*** | -0.011 | 0.532 |
| 4 | 3 | 4.697*** | -0.518*** | -0.009*** | 0.592 | 5.634*** | -0.538*** | -0.039*** | 0.590 |
| | 4 | 6.862*** | -0.536*** | -0.007*** | 0.607 | 6.867*** | -0.546*** | -0.021 | 0.606 |
| | High | 6.983*** | -0.579*** | -0.005*** | 0.585 | 5.034** | -0.577*** | 0.004 | 0.585 |
| | Low | 6.412*** | -0.564*** | -0.011*** | 0.617 | 7.704*** | -0.587*** | -0.048*** | 0.615 |
| | 2 | 1.104 | -0.499*** | -0.013*** | 0.572 | 3.826** | -0.534*** | -0.071*** | 0.569 |
| Big | 3 | 2.967** | -0.571*** | -0.009*** | 0.635 | 3.203* | -0.586*** | -0.031** | 0.634 |
| | 4 | 5.792*** | -0.623*** | -0.015*** | 0.647 | 8.269*** | -0.660*** | -0.075*** | 0.644 |
| | High | 3.023 | -0.592*** | -0.019*** | 0.539 | 7.959*** | -0.648*** | -0.111*** | 0.535 |

**Table 43: Market Timing Results for Equal Weighted North America Index**

Equal Weighted Portfolios sorted on Size and B/M

| | | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| | Low | 6.017*** | -0.503*** | 0.012*** | 0.471 | 0.257 | -0.451*** | 0.106*** | 0.471 |
| | 2 | 6.625*** | -0.501*** | 0.010*** | 0.503 | 1.261 | -0.455*** | 0.092*** | 0.503 |
| Small | 3 | 4.036** | -0.445*** | 0.009*** | 0.511 | -0.058 | -0.407*** | 0.075*** | 0.511 |
| | 4 | 2.713* | -0.395*** | 0.009*** | 0.512 | -0.449 | -0.363*** | 0.065*** | 0.511 |
| | High | 1.264 | -0.309*** | 0.010*** | 0.452 | -2.308 | -0.273*** | 0.074*** | 0.450 |
| | Low | 11.776*** | -0.761*** | -0.004* | 0.553 | 13.381*** | -0.776*** | -0.032 | 0.553 |
| | 2 | 6.865*** | -0.674*** | 0.000 | 0.589 | 8.613*** | -0.685*** | -0.021 | 0.589 |
| 2 | 3 | 3.896** | -0.620*** | -0.005*** | 0.620 | 7.185*** | -0.647*** | -0.052*** | 0.620 |
| | 4 | 2.623* | -0.591*** | -0.002 | 0.614 | 4.729** | -0.606*** | -0.031** | 0.614 |
| | High | 2.552 | -0.596*** | 0.005*** | 0.576 | 3.783* | -0.596*** | 0.002 | 0.575 |
| | Low | 9.745*** | -0.745*** | -0.007*** | 0.564 | 13.119*** | -0.776*** | -0.061*** | 0.564 |
| | 2 | 7.487*** | -0.686*** | -0.006*** | 0.618 | 10.232*** | -0.711*** | -0.051*** | 0.618 |
| 3 | 3 | 4.600*** | -0.604*** | -0.003* | 0.639 | 6.423*** | -0.618*** | -0.030** | 0.639 |
| | 4 | 3.026** | -0.577*** | 0.001 | 0.627 | 3.509* | -0.578*** | -0.001 | 0.627 |
| | High | 3.666** | -0.590*** | 0.002 | 0.602 | 4.113* | -0.590*** | 0.001 | 0.602 |
| | Low | 10.233*** | -0.763*** | -0.013*** | 0.567 | 15.226*** | -0.812*** | -0.098*** | 0.566 |
| | 2 | 5.772*** | -0.661*** | -0.008*** | 0.648 | 9.018*** | -0.692*** | -0.063*** | 0.647 |
| 4 | 3 | 4.465*** | -0.584*** | -0.005*** | 0.661 | 6.130*** | -0.601*** | -0.036*** | 0.660 |
| | 4 | 4.862*** | -0.562*** | -0.003* | 0.616 | 4.702** | -0.565*** | -0.007 | 0.616 |
| | High | 5.943*** | -0.600*** | -0.006*** | 0.591 | 6.949*** | -0.614*** | -0.030* | 0.591 |
| | Low | 5.565*** | -0.685*** | -0.015*** | 0.612 | 11.137*** | -0.740*** | -0.111*** | 0.611 |
| | 2 | 4.931*** | -0.628*** | -0.012*** | 0.699 | 8.347*** | -0.666*** | -0.076*** | 0.698 |
| Big | 3 | 4.120*** | -0.608*** | -0.007*** | 0.684 | 6.161*** | -0.630*** | -0.044*** | 0.684 |
| | 4 | 4.735*** | -0.569*** | -0.010*** | 0.633 | 6.743*** | -0.596*** | -0.054*** | 0.631 |
| | High | 5.664*** | -0.665*** | -0.007*** | 0.614 | 7.584*** | -0.687*** | -0.045*** | 0.614 |

### 2.4.4 Trading Statistics

The following section reports the equal weighted trading statistics for the TIS portfolio via Table 44 to 49. The variables contained are the same as seen in Section 2.3.4.

The Developed Index in Table 44 shows the MA provides considerable risk reduction across all quintiles. The MA signal to buy is not overly frequent with total days not trading of 59% or higher.

**Table 44: Summary Trading Statistics for Equal Weighted Developed Index**

Equal Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 7.72 | 4.73 | 0.66 | 2298 | 0.10 | 0.63 | 0.57 | 383 | 0.59 |
| | 2 | 7.52 | 4.59 | 0.67 | 2251 | 0.10 | 0.63 | 0.58 | 375 | 0.58 |
| Small | 3 | 5.46 | 3.99 | 0.70 | 2227 | 0.07 | 0.62 | 0.58 | 371 | 0.43 |
| | 4 | 4.62 | 3.60 | 0.71 | 2261 | 0.06 | 0.62 | 0.59 | 377 | 0.36 |
| | High | 2.27 | 2.70 | 0.77 | 2070 | 0.03 | 0.64 | 0.63 | 345 | 0.19 |
| | Low | 9.86 | 6.96 | 0.59 | 2638 | 0.11 | 0.62 | 0.54 | 440 | 0.65 |
| | 2 | 7.07 | 5.96 | 0.63 | 2671 | 0.08 | 0.61 | 0.55 | 445 | 0.46 |
| 2 | 3 | 4.70 | 5.41 | 0.64 | 2700 | 0.05 | 0.60 | 0.55 | 450 | 0.30 |
| | 4 | 3.76 | 5.10 | 0.65 | 2672 | 0.04 | 0.59 | 0.54 | 445 | 0.25 |
| | High | 4.03 | 5.06 | 0.65 | 2688 | 0.04 | 0.58 | 0.55 | 448 | 0.26 |
| | Low | 7.31 | 7.51 | 0.61 | 2773 | 0.08 | 0.60 | 0.54 | 462 | 0.46 |
| | 2 | 5.92 | 6.65 | 0.62 | 2761 | 0.06 | 0.60 | 0.54 | 460 | 0.37 |
| 3 | 3 | 3.45 | 5.98 | 0.64 | 2756 | 0.04 | 0.59 | 0.55 | 459 | 0.22 |
| | 4 | 3.65 | 5.77 | 0.64 | 2788 | 0.04 | 0.59 | 0.54 | 465 | 0.23 |
| | High | 3.72 | 5.76 | 0.64 | 2771 | 0.04 | 0.58 | 0.54 | 462 | 0.23 |
| | Low | 5.57 | 7.45 | 0.63 | 2731 | 0.06 | 0.60 | 0.54 | 455 | 0.36 |
| | 2 | 3.02 | 6.26 | 0.65 | 2752 | 0.03 | 0.60 | 0.54 | 459 | 0.19 |
| 4 | 3 | 3.20 | 6.19 | 0.64 | 2860 | 0.03 | 0.59 | 0.54 | 477 | 0.19 |
| | 4 | 2.94 | 6.05 | 0.64 | 2803 | 0.03 | 0.58 | 0.54 | 467 | 0.18 |
| | High | 3.51 | 6.53 | 0.63 | 2819 | 0.04 | 0.58 | 0.54 | 470 | 0.22 |
| | Low | 2.92 | 7.45 | 0.64 | 2870 | 0.03 | 0.59 | 0.54 | 478 | 0.18 |
| | 2 | -0.25 | 6.08 | 0.68 | 2849 | 0.00 | 0.57 | 0.54 | 475 | -0.02 |
| Big | 3 | 1.07 | 6.24 | 0.66 | 2824 | 0.01 | 0.58 | 0.54 | 471 | 0.07 |
| | 4 | 1.25 | 6.67 | 0.65 | 2884 | 0.01 | 0.57 | 0.54 | 481 | 0.08 |
| | High | 0.02 | 7.02 | 0.66 | 2822 | 0.00 | 0.57 | 0.54 | 470 | 0.00 |

In regard to the success rate of the MA, when buying into the portfolio, a positive return occurs at a minimum 57%. This corresponds to a correct choice being undertaken at a minimum 54% of the time, whereby the return accrued is greater than the alternative risk-free rate. The adjusted *BETC*6* is between -2 and 59 basis points and is negatively related to size.

**Table 45: Summary Trading Statistics for Equal Weighted Developed excl. US Index**

Equal Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 7.17 | 4.54 | 0.65 | 2456 | 0.08 | 0.63 | 0.56 | 409 | 0.51 |
| | 2 | 6.97 | 4.49 | 0.65 | 2446 | 0.08 | 0.62 | 0.56 | 408 | 0.50 |
| Small | 3 | 5.24 | 4.10 | 0.67 | 2479 | 0.06 | 0.62 | 0.57 | 413 | 0.37 |
| | 4 | 4.10 | 3.63 | 0.69 | 2413 | 0.05 | 0.62 | 0.58 | 402 | 0.30 |
| | High | 1.63 | 2.80 | 0.76 | 2247 | 0.02 | 0.63 | 0.61 | 374 | 0.13 |
| | Low | 11.54 | 6.79 | 0.56 | 2671 | 0.13 | 0.62 | 0.53 | 445 | 0.75 |
| | 2 | 8.07 | 5.94 | 0.58 | 2642 | 0.09 | 0.61 | 0.53 | 440 | 0.53 |
| 2 | 3 | 5.76 | 5.31 | 0.60 | 2706 | 0.06 | 0.61 | 0.54 | 451 | 0.37 |
| | 4 | 5.03 | 5.04 | 0.62 | 2723 | 0.05 | 0.60 | 0.54 | 454 | 0.32 |
| | High | 4.35 | 5.13 | 0.61 | 2747 | 0.05 | 0.61 | 0.54 | 458 | 0.28 |
| | Low | 8.31 | 6.96 | 0.58 | 2779 | 0.09 | 0.61 | 0.52 | 463 | 0.52 |
| | 2 | 6.77 | 6.36 | 0.59 | 2807 | 0.07 | 0.60 | 0.53 | 468 | 0.42 |
| 3 | 3 | 4.05 | 6.07 | 0.61 | 2857 | 0.04 | 0.59 | 0.53 | 476 | 0.25 |
| | 4 | 3.91 | 5.69 | 0.60 | 2841 | 0.04 | 0.60 | 0.53 | 474 | 0.24 |
| | High | 4.39 | 5.76 | 0.61 | 2773 | 0.05 | 0.59 | 0.53 | 462 | 0.28 |
| | Low | 6.44 | 7.12 | 0.59 | 2876 | 0.07 | 0.61 | 0.53 | 479 | 0.39 |
| | 2 | 3.50 | 6.46 | 0.61 | 2883 | 0.04 | 0.59 | 0.53 | 480 | 0.21 |
| 4 | 3 | 2.52 | 6.16 | 0.62 | 2948 | 0.02 | 0.58 | 0.53 | 491 | 0.15 |
| | 4 | 2.58 | 6.13 | 0.61 | 2898 | 0.03 | 0.59 | 0.53 | 483 | 0.16 |
| | High | 4.70 | 6.63 | 0.59 | 2909 | 0.05 | 0.58 | 0.52 | 485 | 0.28 |
| | Low | 3.45 | 7.22 | 0.61 | 2998 | 0.03 | 0.59 | 0.53 | 500 | 0.20 |
| | 2 | -1.70 | 5.80 | 0.66 | 2953 | -0.02 | 0.57 | 0.53 | 492 | -0.10 |
| Big | 3 | 0.71 | 6.70 | 0.63 | 3003 | 0.01 | 0.57 | 0.53 | 500 | 0.04 |
| | 4 | 0.82 | 7.05 | 0.63 | 3011 | 0.01 | 0.56 | 0.53 | 502 | 0.05 |
| | High | -2.38 | 7.13 | 0.66 | 2994 | -0.02 | 0.56 | 0.53 | 499 | -0.14 |

The Developed excluding US Index in Table 45 shows the risk reducing benefits of the MA, with a minimum number of days not trading at 56%. An MA signal to buy into the portfolio generates a positive return at least 56% of the time, with a minimum 52% of those trades in excess of the risk-free rate. The adjusted *BETC*6* is between -14 and 75 basis points and

appears to be somewhat negatively related to size, although there are inconsistencies across the quintiles.

**Table 46: Summary Trading Statistics for Equal Weighted Japan Index**

Equal Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 11.90 | 9.52 | 0.55 | 2743 | 0.13 | 0.63 | 0.52 | 457 | 0.76 |
| | 2 | 9.15 | 8.00 | 0.57 | 2744 | 0.10 | 0.64 | 0.53 | 457 | 0.58 |
| Small | 3 | 8.17 | 7.43 | 0.58 | 2745 | 0.09 | 0.64 | 0.53 | 458 | 0.52 |
| | 4 | 7.18 | 7.20 | 0.58 | 2784 | 0.07 | 0.63 | 0.53 | 464 | 0.45 |
| | High | 6.55 | 6.51 | 0.58 | 2786 | 0.07 | 0.63 | 0.53 | 464 | 0.41 |
| | Low | 10.63 | 11.19 | 0.52 | 2892 | 0.11 | 0.61 | 0.51 | 482 | 0.64 |
| | 2 | 7.54 | 9.67 | 0.53 | 3014 | 0.07 | 0.62 | 0.52 | 502 | 0.44 |
| 2 | 3 | 4.93 | 9.02 | 0.54 | 3054 | 0.05 | 0.62 | 0.52 | 509 | 0.28 |
| | 4 | 3.32 | 8.59 | 0.57 | 3066 | 0.03 | 0.61 | 0.52 | 511 | 0.19 |
| | High | 3.31 | 8.75 | 0.55 | 3068 | 0.03 | 0.60 | 0.51 | 511 | 0.19 |
| | Low | 9.87 | 11.19 | 0.51 | 2949 | 0.10 | 0.61 | 0.51 | 492 | 0.58 |
| | 2 | 2.47 | 10.12 | 0.55 | 3122 | 0.02 | 0.60 | 0.52 | 520 | 0.14 |
| 3 | 3 | 2.31 | 9.69 | 0.55 | 3045 | 0.02 | 0.61 | 0.51 | 508 | 0.13 |
| | 4 | -0.30 | 9.01 | 0.55 | 3154 | 0.00 | 0.60 | 0.51 | 526 | -0.02 |
| | High | -0.20 | 8.89 | 0.56 | 3168 | 0.00 | 0.60 | 0.51 | 528 | -0.01 |
| | Low | 5.66 | 11.04 | 0.50 | 3095 | 0.05 | 0.60 | 0.51 | 516 | 0.32 |
| | 2 | -1.88 | 9.89 | 0.55 | 3242 | -0.02 | 0.59 | 0.51 | 540 | -0.10 |
| 4 | 3 | -2.80 | 9.50 | 0.55 | 3253 | -0.02 | 0.59 | 0.51 | 542 | -0.15 |
| | 4 | -2.99 | 9.17 | 0.55 | 3273 | -0.03 | 0.59 | 0.51 | 546 | -0.16 |
| | High | -2.63 | 9.65 | 0.54 | 3235 | -0.02 | 0.58 | 0.51 | 539 | -0.14 |
| | Low | -0.76 | 10.89 | 0.53 | 3300 | -0.01 | 0.59 | 0.51 | 550 | -0.04 |
| | 2 | -4.91 | 9.60 | 0.54 | 3377 | -0.04 | 0.58 | 0.51 | 563 | -0.25 |
| Big | 3 | -4.83 | 9.76 | 0.55 | 3313 | -0.04 | 0.58 | 0.51 | 552 | -0.25 |
| | 4 | -5.09 | 9.58 | 0.54 | 3331 | -0.04 | 0.57 | 0.51 | 555 | -0.27 |
| | High | -5.48 | 10.84 | 0.52 | 3314 | -0.05 | 0.56 | 0.50 | 552 | -0.29 |

The Japan Index in Table 46 has even higher risk reduction then the previous indices when using the MA. Utilising the MA for this index leads to a minimum number of non-trading days of 50%. When buying into the portfolio, a positive return is achieved a minimum 56% of the time. The minimum buy trades leading to a return in excess of the risk-free rate is 50%. The adjusted *BETC*6* for the Japan Index has the most volatile results with values between -29 and 76 basis points.

**Table 47: Summary Trading Statistics for Equal Weighted Asia Pacific excl. Japan Index**

Equal Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 5.64 | 6.31 | 0.65 | 2508 | 0.07 | 0.61 | 0.56 | 418 | 0.39 |
| | 2 | 7.42 | 6.18 | 0.65 | 2455 | 0.09 | 0.63 | 0.57 | 409 | 0.53 |
| Small | 3 | 4.99 | 5.82 | 0.68 | 2375 | 0.06 | 0.62 | 0.57 | 396 | 0.37 |
| | 4 | 4.29 | 4.83 | 0.71 | 2349 | 0.05 | 0.62 | 0.59 | 392 | 0.32 |
| | High | 4.13 | 3.76 | 0.75 | 2017 | 0.06 | 0.66 | 0.62 | 336 | 0.36 |
| | Low | 15.54 | 8.72 | 0.50 | 2665 | 0.17 | 0.58 | 0.52 | 444 | 1.02 |
| | 2 | 14.87 | 8.30 | 0.53 | 2578 | 0.17 | 0.58 | 0.51 | 430 | 1.01 |
| 2 | 3 | 11.34 | 7.25 | 0.57 | 2624 | 0.13 | 0.58 | 0.53 | 437 | 0.75 |
| | 4 | 11.23 | 7.22 | 0.59 | 2553 | 0.13 | 0.59 | 0.54 | 426 | 0.77 |
| | High | 10.17 | 6.26 | 0.62 | 2506 | 0.12 | 0.59 | 0.55 | 418 | 0.71 |
| | Low | 15.23 | 10.15 | 0.54 | 2742 | 0.16 | 0.58 | 0.52 | 457 | 0.97 |
| | 2 | 10.36 | 8.42 | 0.57 | 2857 | 0.11 | 0.57 | 0.52 | 476 | 0.63 |
| 3 | 3 | 8.96 | 7.78 | 0.59 | 2764 | 0.09 | 0.57 | 0.53 | 461 | 0.56 |
| | 4 | 8.96 | 7.51 | 0.59 | 2686 | 0.10 | 0.57 | 0.53 | 448 | 0.58 |
| | High | 10.50 | 7.28 | 0.61 | 2614 | 0.12 | 0.59 | 0.54 | 436 | 0.70 |
| | Low | 7.32 | 8.37 | 0.59 | 2890 | 0.07 | 0.57 | 0.53 | 482 | 0.44 |
| | 2 | 6.24 | 7.61 | 0.61 | 2828 | 0.06 | 0.58 | 0.53 | 471 | 0.38 |
| 4 | 3 | 5.73 | 8.34 | 0.60 | 2860 | 0.06 | 0.58 | 0.54 | 477 | 0.35 |
| | 4 | 6.70 | 7.41 | 0.62 | 2717 | 0.07 | 0.58 | 0.54 | 453 | 0.43 |
| | High | 9.03 | 7.73 | 0.62 | 2669 | 0.10 | 0.59 | 0.54 | 445 | 0.59 |
| | Low | 5.30 | 8.93 | 0.60 | 2877 | 0.05 | 0.57 | 0.53 | 480 | 0.32 |
| | 2 | 4.16 | 8.33 | 0.61 | 2857 | 0.04 | 0.57 | 0.53 | 476 | 0.25 |
| Big | 3 | 3.43 | 7.85 | 0.62 | 2945 | 0.03 | 0.57 | 0.53 | 491 | 0.20 |
| | 4 | 3.93 | 7.81 | 0.62 | 2849 | 0.04 | 0.57 | 0.53 | 475 | 0.24 |
| | High | 5.92 | 9.10 | 0.60 | 2833 | 0.06 | 0.57 | 0.53 | 472 | 0.36 |

The Asia Pacific excluding Japan Index in Table 47 provides considerable risk reducing benefits when using the MA over the BH. The MA strategy at a minimum will not trade 50% of the time, with the frequency of a positive return after a buy signal occurring at least 57%. Of those buy trades, the minimum rate this return is in excess of the risk-free rate is 51%. The adjusted *BETC*6* is between 20 and 102 basis points.

**Table 48: Summary Trading Statistics for Equal Weighted Europe Index**

Equal Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 6.18 | 4.87 | 0.61 | 2745 | 0.07 | 0.61 | 0.54 | 458 | 0.39 |
| | 2 | 5.87 | 4.80 | 0.63 | 2689 | 0.06 | 0.60 | 0.54 | 448 | 0.38 |
| Small | 3 | 4.42 | 4.37 | 0.64 | 2687 | 0.05 | 0.60 | 0.54 | 448 | 0.29 |
| | 4 | 3.22 | 4.10 | 0.65 | 2700 | 0.03 | 0.59 | 0.55 | 450 | 0.21 |
| | High | 0.55 | 3.19 | 0.72 | 2645 | 0.01 | 0.60 | 0.57 | 441 | 0.04 |
| | Low | 7.41 | 6.86 | 0.61 | 2771 | 0.08 | 0.60 | 0.52 | 462 | 0.47 |
| | 2 | 5.05 | 6.13 | 0.61 | 2784 | 0.05 | 0.60 | 0.54 | 464 | 0.32 |
| 2 | 3 | 3.75 | 5.92 | 0.63 | 2819 | 0.04 | 0.59 | 0.54 | 470 | 0.23 |
| | 4 | 3.18 | 5.61 | 0.64 | 2806 | 0.03 | 0.58 | 0.54 | 468 | 0.20 |
| | High | 3.37 | 5.77 | 0.64 | 2748 | 0.04 | 0.57 | 0.54 | 458 | 0.21 |
| | Low | 4.46 | 7.90 | 0.61 | 2932 | 0.04 | 0.59 | 0.53 | 489 | 0.26 |
| | 2 | 3.91 | 7.38 | 0.62 | 2895 | 0.04 | 0.58 | 0.53 | 482 | 0.24 |
| 3 | 3 | 2.39 | 6.79 | 0.63 | 2908 | 0.02 | 0.57 | 0.53 | 485 | 0.14 |
| | 4 | 1.85 | 6.76 | 0.62 | 2943 | 0.02 | 0.57 | 0.54 | 490 | 0.11 |
| | High | 3.69 | 7.02 | 0.63 | 2798 | 0.04 | 0.57 | 0.54 | 466 | 0.23 |
| | Low | 0.87 | 7.82 | 0.64 | 2972 | 0.01 | 0.58 | 0.53 | 495 | 0.05 |
| | 2 | -1.42 | 6.78 | 0.65 | 2976 | -0.01 | 0.58 | 0.53 | 496 | -0.08 |
| 4 | 3 | -1.40 | 7.48 | 0.63 | 3041 | -0.01 | 0.57 | 0.53 | 507 | -0.08 |
| | 4 | 1.48 | 7.75 | 0.62 | 2948 | 0.01 | 0.58 | 0.54 | 491 | 0.09 |
| | High | 1.81 | 8.59 | 0.63 | 2976 | 0.02 | 0.56 | 0.54 | 496 | 0.11 |
| | Low | -0.41 | 8.27 | 0.63 | 3097 | 0.00 | 0.57 | 0.53 | 516 | -0.02 |
| | 2 | -6.14 | 6.62 | 0.69 | 3070 | -0.06 | 0.54 | 0.53 | 512 | -0.35 |
| Big | 3 | -3.31 | 7.81 | 0.67 | 2987 | -0.03 | 0.55 | 0.53 | 498 | -0.19 |
| | 4 | -2.90 | 8.65 | 0.64 | 3063 | -0.03 | 0.55 | 0.53 | 510 | -0.16 |
| | High | -6.54 | 8.64 | 0.66 | 3091 | -0.06 | 0.56 | 0.54 | 515 | -0.37 |

The Europe Index in Table 48 shows risk reducing benefits when using the MA, with a minimum number of non-trading days at 61%. A positive return is accrued after a buy into the portfolio a minimum of 54% and of those buys, 53% are in excess of the risk-free rate. The adjusted *BETC*6* is between -37 and 47 basis points

**Table 49: Summary Trading Statistics for Equal Weighted North America Index**

Equal Weighted Portfolios sorted on Size and B/M

| *Portfolio* | | *Δμ* | *Δσ* | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | 5.31 | 7.79 | 0.67 | 2498 | 0.06 | 0.61 | 0.58 | 416 | 0.37 |
| | 2 | 5.14 | 7.54 | 0.67 | 2538 | 0.06 | 0.61 | 0.58 | 423 | 0.35 |
| Small | 3 | 2.82 | 6.52 | 0.70 | 2460 | 0.03 | 0.60 | 0.58 | 410 | 0.20 |
| | 4 | 1.95 | 5.71 | 0.70 | 2535 | 0.02 | 0.60 | 0.59 | 422 | 0.13 |
| | High | 1.54 | 4.62 | 0.75 | 2116 | 0.02 | 0.63 | 0.63 | 353 | 0.13 |
| | Low | 4.19 | 11.67 | 0.60 | 2886 | 0.04 | 0.59 | 0.54 | 481 | 0.25 |
| | 2 | 1.08 | 9.78 | 0.63 | 2938 | 0.01 | 0.59 | 0.55 | 490 | 0.06 |
| 2 | 3 | -2.66 | 8.59 | 0.66 | 2918 | -0.03 | 0.57 | 0.55 | 486 | -0.16 |
| | 4 | -2.94 | 8.28 | 0.66 | 2930 | -0.03 | 0.57 | 0.55 | 488 | -0.18 |
| | High | -1.11 | 8.67 | 0.65 | 2810 | -0.01 | 0.57 | 0.55 | 468 | -0.07 |
| | Low | 1.44 | 11.16 | 0.63 | 2914 | 0.01 | 0.58 | 0.54 | 486 | 0.09 |
| | 2 | 0.01 | 9.78 | 0.64 | 2974 | 0.00 | 0.59 | 0.54 | 496 | 0.00 |
| 3 | 3 | -1.27 | 8.32 | 0.65 | 2904 | -0.01 | 0.58 | 0.54 | 484 | -0.08 |
| | 4 | -1.48 | 7.92 | 0.65 | 2971 | -0.01 | 0.57 | 0.55 | 495 | -0.09 |
| | High | -0.75 | 8.36 | 0.65 | 2865 | -0.01 | 0.57 | 0.55 | 478 | -0.05 |
| | Low | 0.20 | 11.55 | 0.64 | 2979 | 0.00 | 0.58 | 0.54 | 496 | 0.01 |
| | 2 | -2.05 | 9.18 | 0.65 | 3008 | -0.02 | 0.58 | 0.54 | 501 | -0.12 |
| 4 | 3 | -1.93 | 7.92 | 0.66 | 2957 | -0.02 | 0.57 | 0.55 | 493 | -0.11 |
| | 4 | -0.69 | 7.88 | 0.67 | 2875 | -0.01 | 0.58 | 0.55 | 479 | -0.04 |
| | High | -0.71 | 8.60 | 0.65 | 2840 | -0.01 | 0.58 | 0.55 | 473 | -0.04 |
| | Low | -4.36 | 10.03 | 0.65 | 3097 | -0.04 | 0.58 | 0.54 | 516 | -0.25 |
| | 2 | -3.64 | 8.43 | 0.66 | 3073 | -0.03 | 0.57 | 0.54 | 512 | -0.21 |
| Big | 3 | -2.87 | 8.19 | 0.66 | 3038 | -0.03 | 0.57 | 0.54 | 506 | -0.16 |
| | 4 | -2.84 | 7.90 | 0.67 | 3048 | -0.03 | 0.56 | 0.54 | 508 | -0.16 |
| | High | -1.99 | 9.59 | 0.64 | 2943 | -0.02 | 0.57 | 0.54 | 490 | -0.12 |

The North America Index in Table 49 displays risk reducing benefits when using the MA, with index high minimum number of non-trading days at 63%. The MA achieves a positive return following a buy signal at least 56% of the time, whereby the return is above the risk-free rate at least 54% of the time. The adjusted *BETC*6* is between -25 and 37 basis points.

When reviewing the results across all six indices, the minimum and maximum values for *pA* are 50% and 77% respectively. Therefore, an investor using the MA will always hold a position for a greater than or equal number of days as opposed to changing position. With respect to buying into the portfolio and the related performance, the minimum and maximum

value for *p1* is 54% and 66% whilst the minimum and maximum value for *p2* is 50% and 63%. As a result, using the equal weighted indices and the MA, an investor will earn a positive return at least 54% of the time, with that return being greater than the risk-free rate at least 50% of the time.

With respect to the adjusted *NT/6* and *BETC*6* results, the ability of the MA to beat a BH strategy is not as high as seen in value weighted. If it is assumed a worst case 50 basis point transaction cost is accrued, the Asia Pacific excluding Japan Index is best placed to achieve considerable returns after cost when using the MA, specifically for quintile size category *Small, 2* and *3*. The Japan Index also appears capable of a return after cost, although only for the quintile size *Small*.

These results continue to show the MA is a valuable tool in making investment decisions. When viewed in conjunction with the summary statistics and regression results from the previous sections it is clear the MA outperforms the BH at the very least for the smallest sized quintiles. While the outperformance does not hold across all quintiles for all indices, the common thread of the MA is in its ability to substantially reduce risk, irrespective of how a quintile is created and country of origin. While it may seem counterintuitive, a more risk averse investor would be better off utilising the MA over a simple BH even if it requires additional trading.

## 2.5 Equal versus Value Weighted

The following section compares the performance of the MA for value and equal weighted quintiles found in Section 2.3 and 2.4 respectively.

The equal weighted summary statistics show an overall higher mean return for the time horizon relative to value weighted. As a result, the *SR*s for equal weighted BH are generally higher than for the value weighted BH. This leads to a lower change in the *SR* values when using the MA for equal. However, for both value and equal, the risk reduction when using the MA over the BH is significant. For value, the minimum and maximum standard deviation reduction is 3.80% and 11.27% respectively. For equal, the minimum and maximum standard deviation reduction is 2.80% and 11.67% respectively. While not completely consistent, there is a size component to the risk reduction, with generally smaller size quintiles exhibiting higher risk reducing benefits from the MA. Overall an investor will achieve a more efficient risk-return investment irrespective of using the MA for value or equal weighted quintiles.

Regression results show excess return performance overall is more consistent for value. The MA for both equal and value can achieve statistically significant abnormal returns in excess of the BH with both achieving similar minimum and maximum alphas across all six indices. The minimum and maximum statistically significant alpha for value is -4.224% (Japan Quintile *B-2*) and 18.361% (Asia Pacific Quintile *S-Low*) per annum respectively. The minimum and maximum statistically significant alpha for equal is -4.236% (Europe Quintile *B-High*) and 17.478% (Asia Pacific Quintile *2-Low*) per annum respectively. While this may appear to show both weighting methods can achieve similar returns, the true performance differential emerges once transaction costs are considered. Except for a few of the smallest quintiles, equal does not consistently outperform the BH after cost. As a result, an investor attempting to benefit from the MA should use value weighted.

An important similarity between value and equal is the performance of the Asia Pacific excluding Japan Index. As stated previously, the maximum alpha for both weighting methods occurred for this index. Additionally, performance appears to be the least altered by quintile size. There is still a decline in performance as size increases, although far less pronounced than the other indices. Overall, the risk-return profile and potential after-cost return when utilising the MA on the Asia Pacific excluding Japan Index is far superior to all other indices, particularly for the smallest quintiles.

The performance across quintiles for value and equal can be seen graphically in Figure 1-4. Figure 1 and 3 (Figure 2 and 4) show the alphas for value (equal) with the former showing all alphas reported irrespective of statistical significance and the latter setting any alpha not statistically significant with at least 90% confidence to zero.

The figures graphically represent the analysis stated previously. There exists a downward performance trend as size increases although not a consistent relationship, especially for equal. It is interesting to note the quintiles in size category *Small* for equal are lower performance than quintiles in size category *2*, although not for all indices. For smaller quintiles, as book-to-market increases, performance decreases. However, this relationship appears to flatten and even reverse for the biggest quintiles.

Overall, the analysis paints a clear picture. Value weighted outperforms equal weighted for the MA relative to the BH. However, even when not earning a positive excess return, the risk reducing benefits of the MA are significant irrespective of fundamentals, weighting method and target country.

**Figure 1: Value Weighed Alphas Quintiles Comparison**

This figure does not consider whether the alpha is statistically significant and therefore different from zero.

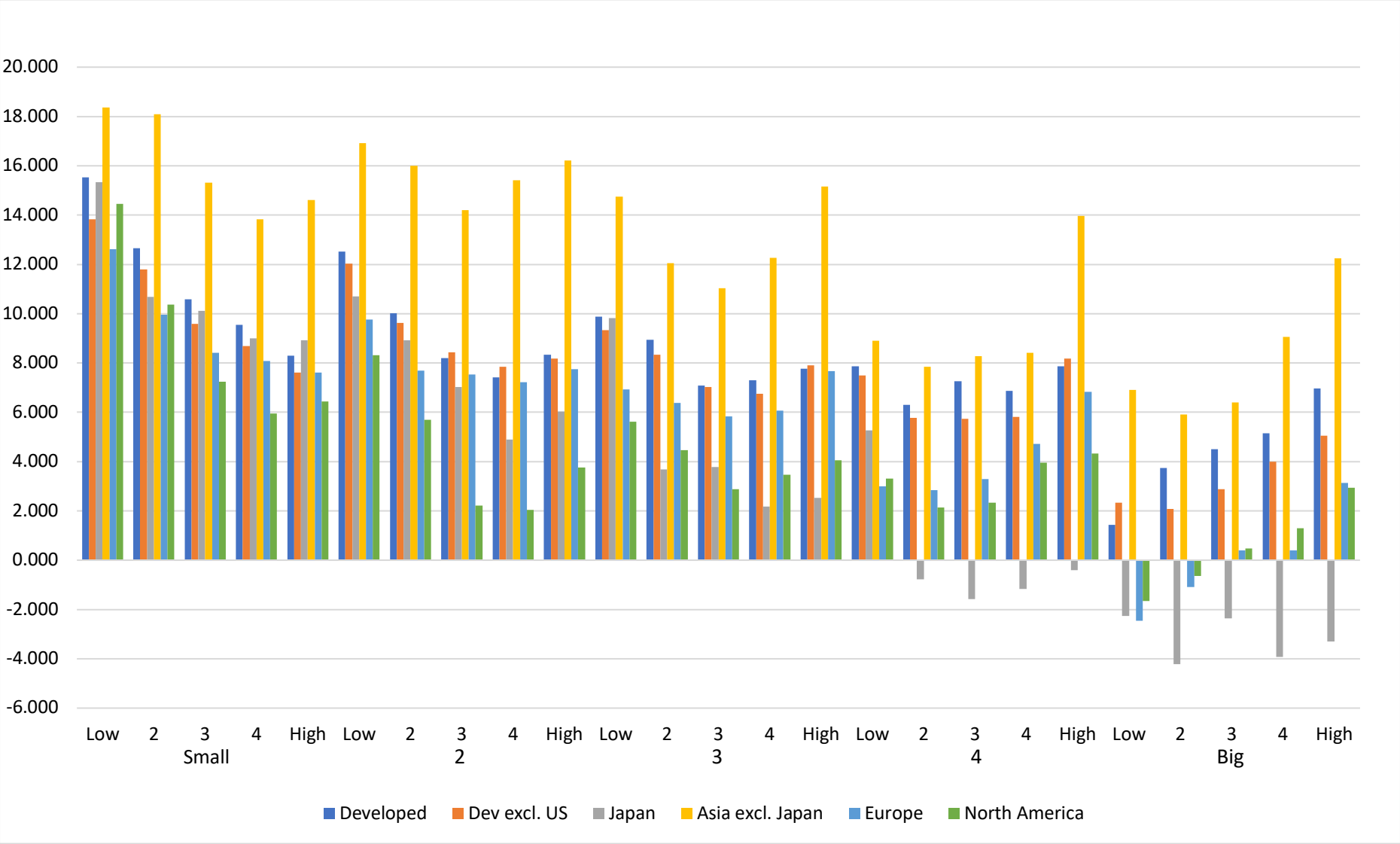


**Figure 2: Equal Weighed Alphas Quintiles Comparison**

This figure does not consider whether the alpha is statistically significant and therefore different from zero.

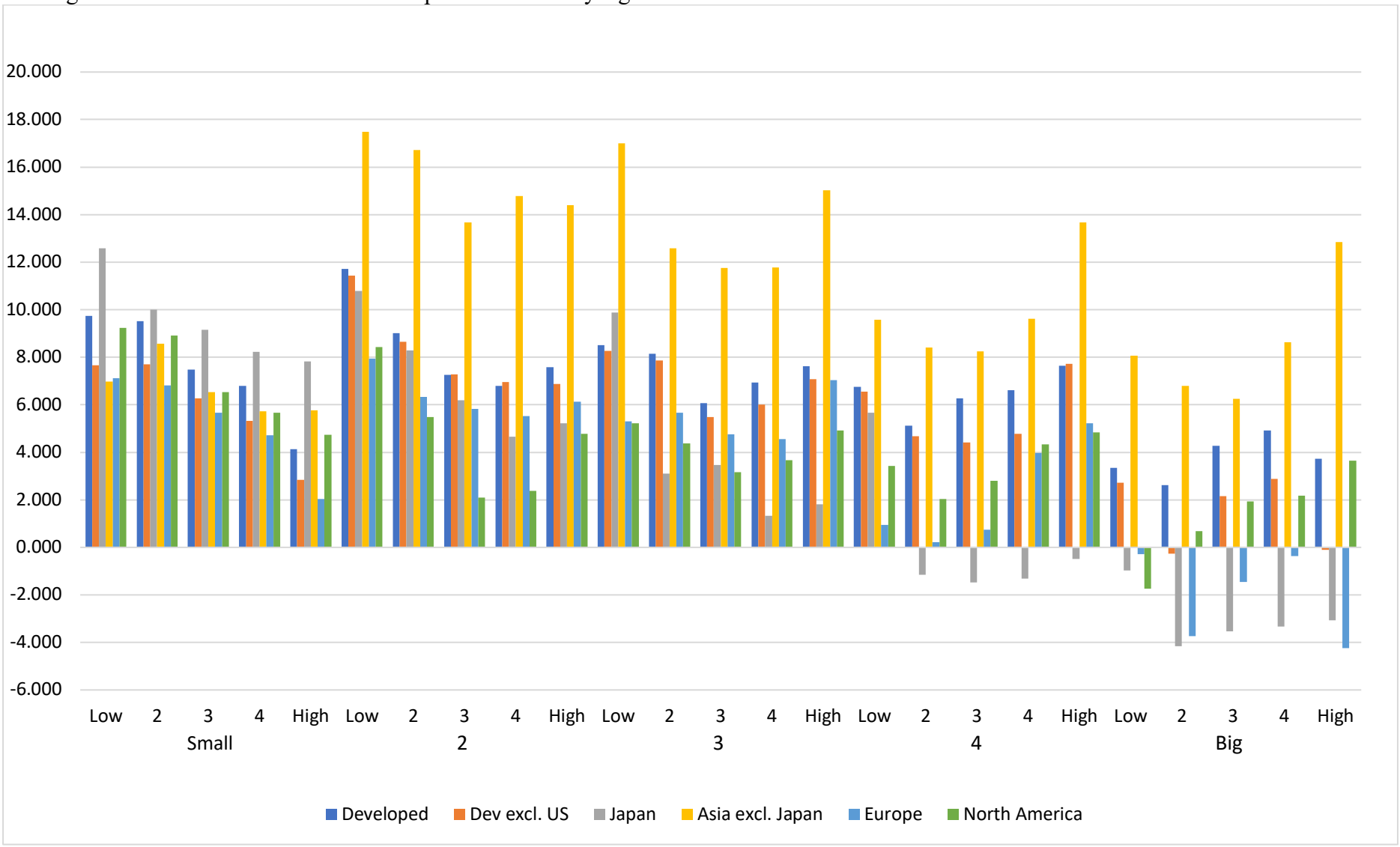


**Figure 3: Value Weighed Alphas Quintiles Comparison**

This figure considers whether the alpha is statistically significant and therefore different from zero. If the alpha was not statistically significant, it is reported as zero for the purposes of the following figure.

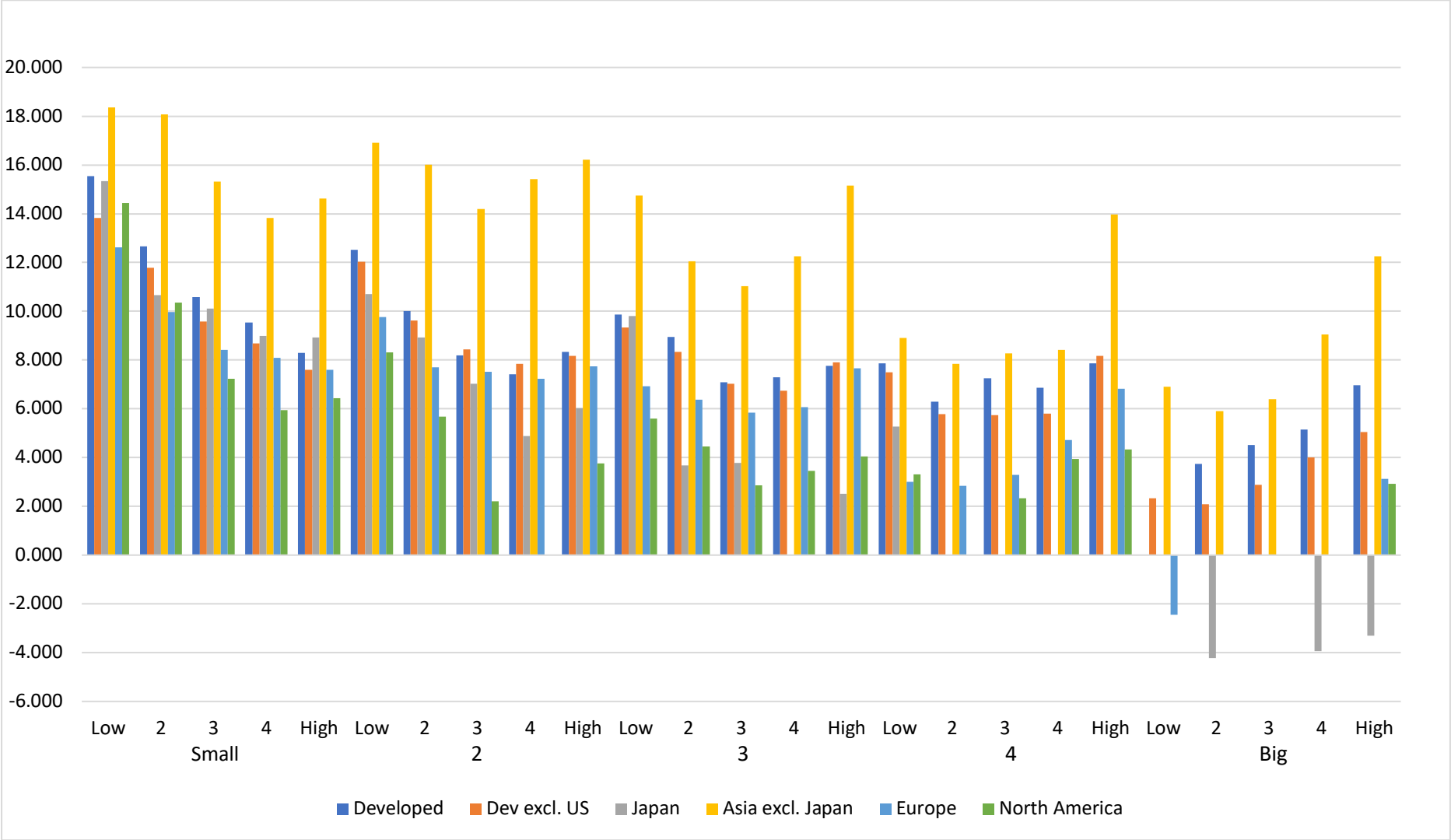
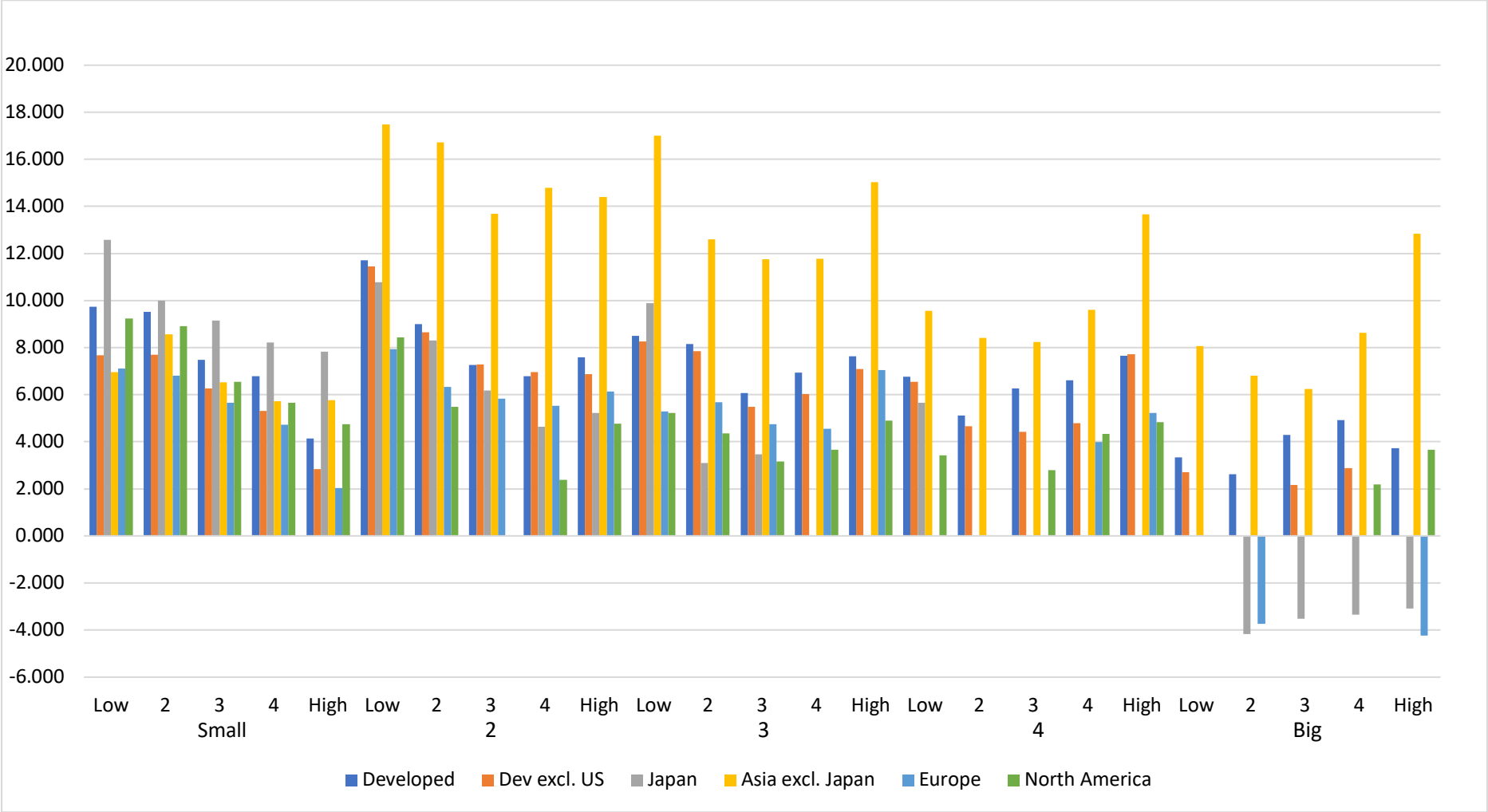


**Figure 4: Equal Weighed Alphas Quintiles Comparison**

This figure considers whether the alpha is statistically significant and therefore different from zero. If the alpha was not statistically significant, it is reported as zero for the purposes of the following figure.



## 2.6 Robustness Checks

The following section contains robustness checks on the previous results in Section 2.3 and 2.4, with two subperiods being utilised to ensure the results are not a result of data mining. Section 2.6 only contains the regression results from model (3) as the other statistics and results reported in previous sections do not add anything to the analysis. The results are reported in Table 50 – 61 with both value and equal weighted results shown. The time horizon subperiods utilised in this section are January 1, 1991 to December 31, 2004 and January 3, 2005 to October 31, 2018 with daily returns used.

Overall, when reviewing the Developed including and excluding US Index for both value and equal weighted in Table 50 and 51, it is clear the MA relative to the BH continues to be an effective trading strategy with strong positive statistically significant alphas for almost all quintiles. However, there does appear to be a drop in performance for the second time period relative to the first. The drop in performance is less pronounced for the Developed excluding US index. The reason for this finding can be seen in the results for the North America Index in Table 60 and 61, with a huge drop off in performance in the second time period, with a majority of quintiles returning statistically insignificant results.

The Japan Index has the most significant drop in performance, with the bigger quintiles moving to large negative statistically significant alphas for the second time period. As stated previously, the North America Index also has a large decline in performance, although unlike the Japan Index, none of the quintiles return statistically significant negative results.

The Europe Index does not seem to be largely altered across the two time periods, with similar results for each quintile on average, with some quintiles improving and some quintiles worsening.

**Table 50: Subperiod Factor Regression Results for Value Weighted Developed Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
| | Low | 17.550*** | -0.608*** | -0.675*** | 0.126*** | 0.014 | 0.605 | 13.834*** | -0.622*** | -0.625*** | 0.233*** | 0.000 | 0.678 |
| | 2 | 13.398*** | -0.535*** | -0.579*** | 0.075*** | 0.017* | 0.613 | 11.941*** | -0.568*** | -0.489*** | 0.164*** | -0.002 | 0.672 |
| Small | 3 | 10.646*** | -0.483*** | -0.516*** | -0.004 | -0.016* | 0.594 | 10.625*** | -0.540*** | -0.428*** | 0.141*** | 0.009 | 0.686 |
| | 4 | 8.661*** | -0.412*** | -0.427*** | -0.088*** | -0.025*** | 0.575 | 10.413*** | -0.523*** | -0.445*** | 0.066*** | 0.013 | 0.705 |
| | High | 6.645*** | -0.365*** | -0.381*** | -0.168*** | -0.021*** | 0.544 | 9.732*** | -0.461*** | -0.519*** | -0.071*** | -0.014 | 0.665 |
| | Low | 15.373*** | -0.693*** | -0.637*** | 0.285*** | 0.054*** | 0.701 | 10.039*** | -0.672*** | -0.486*** | 0.358*** | 0.019 | 0.727 |
| | 2 | 11.170*** | -0.603*** | -0.514*** | 0.131*** | 0.060*** | 0.681 | 9.106*** | -0.625*** | -0.375*** | 0.251*** | 0.033*** | 0.713 |
| 2 | 3 | 8.488*** | -0.532*** | -0.427*** | -0.021 | 0.033*** | 0.656 | 8.194*** | -0.606*** | -0.357*** | 0.192*** | 0.045*** | 0.724 |
| | 4 | 7.186*** | -0.475*** | -0.347*** | -0.145*** | 0.019** | 0.616 | 7.718*** | -0.609*** | -0.361*** | 0.052** | 0.032*** | 0.721 |
| | High | 8.432*** | -0.506*** | -0.390*** | -0.278*** | 0.007 | 0.624 | 8.337*** | -0.589*** | -0.466*** | -0.131*** | 0.004 | 0.715 |
| | Low | 11.873*** | -0.713*** | -0.531*** | 0.387*** | 0.088*** | 0.692 | 7.977*** | -0.657*** | -0.297*** | 0.352*** | 0.037*** | 0.716 |
| | 2 | 9.937*** | -0.651*** | -0.429*** | 0.156*** | 0.038*** | 0.674 | 8.304*** | -0.653*** | -0.272*** | 0.269*** | 0.020* | 0.724 |
| 3 | 3 | 7.702*** | -0.574*** | -0.324*** | -0.049*** | 0.067*** | 0.642 | 6.893*** | -0.623*** | -0.216*** | 0.171*** | 0.050*** | 0.725 |
| | 4 | 7.094*** | -0.523*** | -0.263*** | -0.221*** | 0.041*** | 0.613 | 7.938*** | -0.630*** | -0.222*** | 0.074*** | 0.039*** | 0.735 |
| | High | 7.928*** | -0.541*** | -0.300*** | -0.340*** | 0.037*** | 0.621 | 7.822*** | -0.624*** | -0.276*** | -0.127*** | 0.014 | 0.729 |
| | Low | 9.180*** | -0.708*** | -0.388*** | 0.428*** | 0.065*** | 0.682 | 6.497*** | -0.631*** | -0.120*** | 0.335*** | 0.028** | 0.706 |
| | 2 | 6.400*** | -0.581*** | -0.238*** | 0.060*** | 0.075*** | 0.657 | 6.578*** | -0.627*** | -0.101*** | 0.256*** | 0.019 | 0.719 |
| 4 | 3 | 8.065*** | -0.590*** | -0.206*** | -0.171*** | 0.045*** | 0.662 | 7.273*** | -0.636*** | -0.109*** | 0.168*** | 0.024** | 0.731 |
| | 4 | 6.413*** | -0.530*** | -0.157*** | -0.297*** | 0.042*** | 0.613 | 7.924*** | -0.625*** | -0.139*** | 0.052** | 0.010 | 0.724 |
| | High | 7.946*** | -0.550*** | -0.166*** | -0.364*** | 0.037*** | 0.620 | 8.127*** | -0.659*** | -0.081*** | -0.094*** | 0.046*** | 0.733 |
| | Low | -1.044 | -0.465*** | 0.155*** | 0.645*** | 0.132*** | 0.705 | 2.954** | -0.545*** | 0.262*** | 0.427*** | 0.017 | 0.724 |
| | 2 | 4.309*** | -0.562*** | 0.131*** | 0.040** | 0.065*** | 0.681 | 3.891*** | -0.553*** | 0.256*** | 0.286*** | -0.049*** | 0.750 |
| Big | 3 | 4.112*** | -0.559*** | 0.075*** | -0.132*** | 0.053*** | 0.662 | 5.591*** | -0.623*** | 0.198*** | 0.167*** | 0.012 | 0.754 |
| | 4 | 5.113*** | -0.566*** | 0.052*** | -0.236*** | 0.043*** | 0.637 | 5.490*** | -0.630*** | 0.327*** | -0.009 | 0.024** | 0.753 |
| | High | 5.692*** | -0.605*** | 0.108*** | -0.280*** | 0.080*** | 0.624 | 7.484*** | -0.740*** | 0.311*** | -0.307*** | 0.104*** | 0.748 |

**Table 51: Subperiod Factor Regression Results for Value Weighted Developed excl. US Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
| | Low | 13.564*** | -0.542*** | -0.547*** | 0.318*** | 0.033*** | 0.611 | 13.723*** | -0.620*** | -0.570*** | 0.232*** | 0.002 | 0.696 |
| | 2 | 10.443*** | -0.494*** | -0.516*** | 0.182*** | 0.018* | 0.592 | 12.690*** | -0.561*** | -0.452*** | 0.178*** | 0.008 | 0.685 |
| Small | 3 | 8.236*** | -0.472*** | -0.477*** | 0.077*** | -0.005 | 0.584 | 10.717*** | -0.527*** | -0.421*** | 0.166*** | 0.027** | 0.683 |
| | 4 | 6.258*** | -0.423*** | -0.436*** | -0.037*** | -0.007 | 0.571 | 11.071*** | -0.522*** | -0.438*** | 0.125*** | 0.023** | 0.699 |
| | High | 5.937*** | -0.427*** | -0.445*** | -0.162*** | -0.007 | 0.568 | 9.373*** | -0.486*** | -0.544*** | 0.014 | 0.001 | 0.677 |
| | Low | 12.926*** | -0.613*** | -0.540*** | 0.339*** | 0.065*** | 0.680 | 11.046*** | -0.664*** | -0.529*** | 0.383*** | 0.035*** | 0.716 |
| | 2 | 9.193*** | -0.543*** | -0.496*** | 0.192*** | 0.061*** | 0.634 | 9.785*** | -0.617*** | -0.425*** | 0.268*** | 0.068*** | 0.712 |
| 2 | 3 | 8.268*** | -0.541*** | -0.476*** | -0.019 | 0.021** | 0.638 | 8.616*** | -0.596*** | -0.446*** | 0.173*** | 0.050*** | 0.710 |
| | 4 | 6.647*** | -0.505*** | -0.446*** | -0.130*** | 0.022** | 0.617 | 9.111*** | -0.588*** | -0.478*** | 0.052*** | 0.032*** | 0.716 |
| | High | 8.896*** | -0.563*** | -0.478*** | -0.273*** | 0.007 | 0.615 | 7.809*** | -0.591*** | -0.593*** | -0.083*** | 0.008 | 0.693 |
| | Low | 9.969*** | -0.619*** | -0.459*** | 0.401*** | 0.083*** | 0.647 | 8.268*** | -0.645*** | -0.322*** | 0.369*** | 0.045*** | 0.714 |
| | 2 | 8.586*** | -0.577*** | -0.422*** | 0.074*** | 0.042*** | 0.636 | 8.092*** | -0.638*** | -0.290*** | 0.265*** | 0.059*** | 0.719 |
| 3 | 3 | 6.353*** | -0.574*** | -0.400*** | -0.075*** | 0.065*** | 0.601 | 8.032*** | -0.619*** | -0.305*** | 0.211*** | 0.069*** | 0.718 |
| | 4 | 6.190*** | -0.548*** | -0.368*** | -0.204*** | 0.030*** | 0.572 | 7.690*** | -0.621*** | -0.378*** | 0.095*** | 0.055*** | 0.717 |
| | High | 7.606*** | -0.570*** | -0.368*** | -0.260*** | 0.027*** | 0.612 | 8.331*** | -0.622*** | -0.418*** | -0.095*** | 0.024** | 0.709 |
| | Low | 9.569*** | -0.638*** | -0.314*** | 0.342*** | 0.071*** | 0.660 | 5.298*** | -0.620*** | -0.163*** | 0.361*** | 0.044*** | 0.704 |
| | 2 | 5.268*** | -0.574*** | -0.295*** | -0.010 | 0.061*** | 0.627 | 6.606*** | -0.620*** | -0.190*** | 0.257*** | 0.044*** | 0.714 |
| 4 | 3 | 6.090*** | -0.576*** | -0.270*** | -0.118*** | 0.053*** | 0.625 | 5.728*** | -0.627*** | -0.185*** | 0.171*** | 0.073*** | 0.727 |
| | 4 | 4.906*** | -0.554*** | -0.249*** | -0.181*** | 0.030*** | 0.615 | 7.058*** | -0.625*** | -0.224*** | 0.084*** | 0.021* | 0.726 |
| | High | 7.287*** | -0.573*** | -0.236*** | -0.271*** | 0.022** | 0.618 | 9.190*** | -0.678*** | -0.263*** | -0.093*** | 0.062*** | 0.726 |
| | Low | 1.196 | -0.553*** | 0.133*** | 0.576*** | 0.098*** | 0.688 | 3.402** | -0.567*** | 0.133*** | 0.525*** | 0.061*** | 0.725 |
| | 2 | 1.109 | -0.511*** | 0.217*** | 0.133*** | 0.071*** | 0.678 | 3.706** | -0.552*** | 0.161*** | 0.369*** | -0.005 | 0.737 |
| Big | 3 | 0.100 | -0.484*** | 0.191*** | -0.020 | 0.080*** | 0.661 | 6.232*** | -0.642*** | 0.089*** | 0.264*** | 0.064*** | 0.747 |
| | 4 | 2.010 | -0.508*** | 0.139*** | -0.109*** | 0.047*** | 0.626 | 5.674*** | -0.603*** | 0.314*** | -0.039* | -0.007 | 0.732 |
| | High | 2.626 | -0.504*** | 0.292*** | -0.282*** | 0.055*** | 0.606 | 6.869*** | -0.691*** | 0.370*** | -0.230*** | 0.134*** | 0.727 |

**Table 52: Subperiod Factor Regression Results for Value Weighted Japan Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
| | Low | 23.090*** | -0.566*** | -0.640*** | -0.007 | 0.093*** | 0.632 | 7.434*** | -0.642*** | -0.759*** | 0.282*** | 0.034** | 0.677 |
| | 2 | 17.725*** | -0.506*** | -0.560*** | -0.067*** | 0.070*** | 0.628 | 3.395* | -0.545*** | -0.630*** | 0.111*** | 0.030*** | 0.671 |
| Small | 3 | 17.239*** | -0.524*** | -0.598*** | -0.070*** | -0.034*** | 0.641 | 2.490 | -0.513*** | -0.588*** | 0.031* | 0.034*** | 0.667 |
| | 4 | 15.916*** | -0.483*** | -0.547*** | -0.114*** | 0.015 | 0.649 | 1.578 | -0.512*** | -0.532*** | 0.002 | 0.032*** | 0.677 |
| | High | 16.364*** | -0.479*** | -0.514*** | -0.190*** | 0.034*** | 0.675 | 0.851 | -0.473*** | -0.519*** | -0.108*** | 0.016* | 0.686 |
| | Low | 17.602*** | -0.641*** | -0.596*** | 0.213*** | -0.026** | 0.690 | 3.733* | -0.654*** | -0.669*** | 0.382*** | 0.053*** | 0.702 |
| | 2 | 17.979*** | -0.626*** | -0.565*** | 0.067*** | 0.057*** | 0.691 | -0.622 | -0.573*** | -0.519*** | 0.125*** | 0.048*** | 0.695 |
| 2 | 3 | 14.817*** | -0.568*** | -0.494*** | -0.090*** | 0.087*** | 0.677 | -0.895 | -0.591*** | -0.532*** | -0.011 | 0.037*** | 0.711 |
| | 4 | 11.593*** | -0.563*** | -0.472*** | -0.123*** | 0.079*** | 0.684 | -2.115 | -0.575*** | -0.469*** | -0.010 | 0.062*** | 0.696 |
| | High | 14.430*** | -0.601*** | -0.489*** | -0.254*** | 0.037*** | 0.714 | -2.614 | -0.601*** | -0.517*** | -0.167*** | 0.020** | 0.722 |
| | Low | 16.955*** | -0.638*** | -0.464*** | 0.198*** | 0.045*** | 0.654 | 3.072 | -0.642*** | -0.537*** | 0.381*** | 0.028** | 0.694 |
| | 2 | 10.944*** | -0.621*** | -0.411*** | 0.129*** | 0.012 | 0.673 | -4.004* | -0.619*** | -0.390*** | 0.149*** | 0.097*** | 0.698 |
| 3 | 3 | 11.240*** | -0.599*** | -0.366*** | -0.087*** | 0.114*** | 0.684 | -3.911** | -0.591*** | -0.369*** | 0.075*** | 0.065*** | 0.691 |
| | 4 | 9.229*** | -0.572*** | -0.339*** | -0.193*** | 0.096*** | 0.677 | -4.832*** | -0.604*** | -0.406*** | -0.081*** | 0.023** | 0.695 |
| | High | 10.356*** | -0.593*** | -0.361*** | -0.276*** | 0.047*** | 0.693 | -5.492*** | -0.608*** | -0.389*** | -0.192*** | -0.001 | 0.699 |
| | Low | 12.229*** | -0.648*** | -0.288*** | 0.238*** | -0.033*** | 0.682 | -1.415 | -0.629*** | -0.270*** | 0.429*** | 0.050*** | 0.698 |
| | 2 | 6.576*** | -0.601*** | -0.213*** | 0.041** | 0.064*** | 0.672 | -8.098*** | -0.575*** | -0.193*** | 0.182*** | 0.057*** | 0.680 |
| 4 | 3 | 3.811* | -0.559*** | -0.158*** | -0.118*** | 0.063*** | 0.654 | -6.722*** | -0.595*** | -0.183*** | 0.063*** | 0.041*** | 0.703 |
| | 4 | 4.562** | -0.556*** | -0.165*** | -0.225*** | 0.076*** | 0.662 | -6.668*** | -0.601*** | -0.194*** | -0.029* | 0.023** | 0.703 |
| | High | 7.404*** | -0.596*** | -0.210*** | -0.300*** | 0.099*** | 0.661 | -8.426*** | -0.620*** | -0.208*** | -0.200*** | 0.008 | 0.691 |
| | Low | 2.160 | -0.609*** | 0.108*** | 0.465*** | 0.061*** | 0.718 | -6.600*** | -0.584*** | 0.095*** | 0.448*** | 0.042*** | 0.722 |
| | 2 | 0.201 | -0.530*** | 0.123*** | 0.116*** | 0.108*** | 0.682 | -8.054*** | -0.595*** | 0.074*** | 0.222*** | 0.041*** | 0.720 |
| Big | 3 | 2.909 | -0.558*** | 0.069*** | -0.096*** | 0.073*** | 0.693 | -7.299*** | -0.618*** | 0.093*** | 0.148*** | 0.111*** | 0.714 |
| | 4 | 0.676 | -0.558*** | 0.094*** | -0.212*** | 0.029** | 0.658 | -7.965*** | -0.601*** | 0.006 | -0.110*** | -0.045*** | 0.701 |
| | High | 1.954 | -0.608*** | 0.076*** | -0.428*** | -0.016 | 0.598 | -7.980*** | -0.672*** | 0.007 | -0.215*** | 0.085*** | 0.689 |

**Table 53: Subperiod Factor Regression Results for Value Weighted Asia Pacific excl. Japan Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* |
| | Low | 16.575*** | -0.640*** | -0.571*** | 0.175*** | -0.026** | 0.484 | 20.363*** | -0.613*** | -0.554*** | 0.181*** | -0.089*** | 0.657 |
| | 2 | 17.654*** | -0.602*** | -0.549*** | 0.104*** | -0.002 | 0.542 | 18.436*** | -0.637*** | -0.543*** | 0.148*** | -0.056*** | 0.681 |
| Small | 3 | 13.497*** | -0.569*** | -0.493*** | 0.054*** | -0.021** | 0.534 | 17.414*** | -0.604*** | -0.520*** | 0.084*** | -0.055*** | 0.687 |
| | 4 | 12.163*** | -0.486*** | -0.430*** | 0.012 | -0.017** | 0.550 | 15.663*** | -0.542*** | -0.479*** | 0.021 | -0.033*** | 0.679 |
| | High | 14.740*** | -0.448*** | -0.417*** | -0.120*** | -0.029*** | 0.568 | 14.463*** | -0.496*** | -0.448*** | -0.124*** | -0.052*** | 0.680 |
| | Low | 14.875*** | -0.620*** | -0.454*** | 0.189*** | 0.020** | 0.566 | 19.312*** | -0.682*** | -0.646*** | 0.172*** | -0.091*** | 0.698 |
| | 2 | 13.726*** | -0.637*** | -0.494*** | 0.108*** | 0.065*** | 0.563 | 18.422*** | -0.682*** | -0.597*** | 0.139*** | -0.029** | 0.695 |
| 2 | 3 | 12.560*** | -0.581*** | -0.437*** | 0.053*** | 0.032*** | 0.580 | 15.985*** | -0.639*** | -0.559*** | 0.065*** | -0.090*** | 0.698 |
| | 4 | 14.709*** | -0.582*** | -0.453*** | -0.094*** | -0.050*** | 0.592 | 16.223*** | -0.641*** | -0.489*** | -0.017 | -0.058*** | 0.711 |
| | High | 16.037*** | -0.583*** | -0.465*** | -0.240*** | 0.003 | 0.567 | 16.547*** | -0.615*** | -0.534*** | -0.243*** | -0.093*** | 0.689 |
| | Low | 14.063*** | -0.616*** | -0.389*** | 0.220*** | 0.071*** | 0.543 | 15.992*** | -0.751*** | -0.519*** | 0.226*** | -0.170*** | 0.694 |
| | 2 | 10.172*** | -0.558*** | -0.384*** | 0.112*** | -0.025** | 0.509 | 14.262*** | -0.694*** | -0.465*** | 0.109*** | -0.021 | 0.693 |
| 3 | 3 | 9.076*** | -0.509*** | -0.285*** | 0.056*** | -0.030*** | 0.510 | 13.279*** | -0.695*** | -0.405*** | 0.073*** | -0.003 | 0.689 |
| | 4 | 10.998*** | -0.561*** | -0.377*** | -0.063*** | 0.022** | 0.527 | 13.510*** | -0.585*** | -0.387*** | 0.000 | 0.018 | 0.665 |
| | High | 15.903*** | -0.612*** | -0.363*** | -0.233*** | 0.062*** | 0.542 | 14.155*** | -0.583*** | -0.380*** | -0.151*** | -0.058*** | 0.692 |
| | Low | 9.405*** | -0.566*** | -0.335*** | 0.102*** | 0.003 | 0.512 | 8.826*** | -0.658*** | -0.231*** | 0.191*** | -0.021 | 0.679 |
| | 2 | 4.430** | -0.449*** | -0.181*** | 0.109*** | -0.014 | 0.499 | 11.726*** | -0.627*** | -0.206*** | 0.140*** | -0.008 | 0.662 |
| 4 | 3 | 5.566** | -0.553*** | -0.157*** | 0.202*** | -0.042*** | 0.356 | 10.939*** | -0.630*** | -0.197*** | 0.092*** | 0.006 | 0.690 |
| | 4 | 8.115*** | -0.525*** | -0.227*** | -0.016 | 0.021** | 0.531 | 8.911*** | -0.612*** | -0.195*** | 0.082*** | -0.013 | 0.670 |
| | High | 15.063*** | -0.634*** | -0.191*** | -0.191*** | 0.019 | 0.559 | 12.403*** | -0.593*** | -0.225*** | -0.117*** | -0.034*** | 0.649 |
| | Low | 5.987*** | -0.652*** | 0.044** | 0.351*** | -0.018* | 0.607 | 7.831*** | -0.634*** | 0.149*** | 0.412*** | -0.091*** | 0.728 |
| | 2 | 5.949*** | -0.568*** | 0.029* | 0.189*** | -0.014 | 0.649 | 6.152*** | -0.592*** | 0.131*** | 0.270*** | -0.017 | 0.702 |
| Big | 3 | 7.184*** | -0.650*** | -0.091*** | 0.049*** | 0.039*** | 0.634 | 5.869*** | -0.617*** | 0.110*** | 0.116*** | 0.026** | 0.697 |
| | 4 | 8.973*** | -0.571*** | 0.064*** | -0.153*** | 0.012 | 0.589 | 9.332*** | -0.591*** | 0.049*** | -0.139*** | -0.024** | 0.708 |
| | High | 13.562*** | -0.654*** | 0.139*** | -0.318*** | 0.094*** | 0.600 | 11.208*** | -0.657*** | 0.057*** | -0.348*** | -0.062*** | 0.659 |

**Table 54: Subperiod Factor Regression Results for Value Weighted Europe Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ |
| | Low | 11.829*** | -0.568*** | -0.550*** | 0.301*** | 0.061*** | 0.617 | 12.799*** | -0.550*** | -0.537*** | 0.157*** | 0.027*** | 0.683 |
| | 2 | 8.416*** | -0.536*** | -0.517*** | 0.203*** | 0.058*** | 0.632 | 11.054*** | -0.511*** | -0.477*** | 0.153*** | 0.034*** | 0.672 |
| Small | 3 | 7.054*** | -0.506*** | -0.487*** | 0.071*** | 0.028*** | 0.625 | 9.814*** | -0.483*** | -0.439*** | 0.127*** | 0.038*** | 0.662 |
| | 4 | 5.318*** | -0.456*** | -0.445*** | -0.045*** | 0.012 | 0.596 | 11.093*** | -0.481*** | -0.441*** | 0.089*** | 0.043*** | 0.678 |
| | High | 3.833*** | -0.412*** | -0.403*** | -0.128*** | -0.009 | 0.572 | 11.502*** | -0.460*** | -0.425*** | 0.001 | 0.021** | 0.685 |
| | Low | 10.994*** | -0.598*** | -0.511*** | 0.383*** | 0.069*** | 0.652 | 7.886*** | -0.609*** | -0.454*** | 0.300*** | 0.069*** | 0.689 |
| | 2 | 6.871*** | -0.535*** | -0.486*** | 0.152*** | 0.077*** | 0.624 | 8.218*** | -0.590*** | -0.431*** | 0.194*** | 0.070*** | 0.700 |
| 2 | 3 | 6.191*** | -0.488*** | -0.424*** | -0.014 | 0.012 | 0.611 | 8.917*** | -0.584*** | -0.425*** | 0.129*** | 0.077*** | 0.707 |
| | 4 | 4.768*** | -0.461*** | -0.411*** | -0.133*** | 0.008 | 0.569 | 9.965*** | -0.584*** | -0.401*** | 0.097*** | 0.066*** | 0.712 |
| | High | 4.969*** | -0.467*** | -0.391*** | -0.183*** | 0.006 | 0.572 | 10.224*** | -0.579*** | -0.417*** | -0.085*** | 0.050*** | 0.718 |
| | Low | 7.313*** | -0.593*** | -0.414*** | 0.467*** | 0.111*** | 0.623 | 5.172*** | -0.658*** | -0.327*** | 0.306*** | 0.055*** | 0.690 |
| | 2 | 6.355*** | -0.531*** | -0.392*** | 0.078*** | 0.035*** | 0.601 | 6.421*** | -0.666*** | -0.330*** | 0.273*** | 0.080*** | 0.696 |
| 3 | 3 | 5.018*** | -0.508*** | -0.372*** | -0.112*** | 0.041*** | 0.583 | 7.067*** | -0.641*** | -0.320*** | 0.174*** | 0.081*** | 0.713 |
| | 4 | 5.337*** | -0.504*** | -0.352*** | -0.170*** | 0.019** | 0.573 | 7.063*** | -0.650*** | -0.356*** | 0.092*** | 0.064*** | 0.718 |
| | High | 5.824*** | -0.495*** | -0.320*** | -0.215*** | 0.025*** | 0.559 | 9.025*** | -0.642*** | -0.333*** | -0.120*** | 0.063*** | 0.722 |
| | Low | 2.327 | -0.580*** | -0.253*** | 0.458*** | 0.116*** | 0.628 | 2.776 | -0.629*** | -0.132*** | 0.375*** | 0.089*** | 0.695 |
| | 2 | 3.475** | -0.538*** | -0.255*** | 0.011 | 0.070*** | 0.600 | 2.632 | -0.637*** | -0.127*** | 0.290*** | 0.083*** | 0.711 |
| 4 | 3 | 3.687*** | -0.511*** | -0.217*** | -0.105*** | 0.052*** | 0.603 | 3.308* | -0.639*** | -0.119*** | 0.185*** | 0.090*** | 0.725 |
| | 4 | 4.032*** | -0.516*** | -0.197*** | -0.168*** | 0.054*** | 0.592 | 5.830*** | -0.660*** | -0.178*** | 0.102*** | 0.120*** | 0.722 |
| | High | 5.154*** | -0.488*** | -0.187*** | -0.244*** | 0.026*** | 0.575 | 7.819*** | -0.713*** | -0.108*** | -0.115*** | 0.131*** | 0.745 |
| | Low | -4.269** | -0.511*** | 0.175*** | 0.647*** | 0.159*** | 0.689 | -1.413 | -0.516*** | 0.247*** | 0.534*** | 0.084*** | 0.722 |
| | 2 | -2.049 | -0.492*** | 0.175*** | 0.127*** | 0.068*** | 0.666 | 0.610 | -0.547*** | 0.212*** | 0.375*** | 0.010 | 0.742 |
| Big | 3 | -1.340 | -0.496*** | 0.162*** | 0.003 | 0.105*** | 0.664 | 2.831 | -0.624*** | 0.216*** | 0.294*** | 0.067*** | 0.754 |
| | 4 | -1.680 | -0.515*** | 0.148*** | -0.119*** | 0.081*** | 0.634 | 1.617 | -0.606*** | 0.320*** | -0.108*** | 0.008 | 0.729 |
| | High | 2.636 | -0.541*** | 0.190*** | -0.242*** | 0.118*** | 0.649 | 2.850 | -0.682*** | 0.265*** | -0.243*** | 0.240*** | 0.744 |

**Table 55: Subperiod Factor Regression Results for Value Weighted North America Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ |
| | Low | 22.918*** | -0.655*** | -0.713*** | 0.074*** | 0.064*** | 0.647 | 7.168*** | -0.706*** | -0.511*** | 0.278*** | 0.026** | 0.720 |
| | 2 | 17.368*** | -0.605*** | -0.613*** | -0.011 | 0.043*** | 0.655 | 4.246* | -0.670*** | -0.403*** | 0.157*** | 0.014 | 0.724 |
| Small | 3 | 13.102*** | -0.538*** | -0.524*** | -0.107*** | 0.030*** | 0.639 | 2.118 | -0.626*** | -0.364*** | 0.078*** | 0.014 | 0.724 |
| | 4 | 10.067*** | -0.445*** | -0.420*** | -0.161*** | 0.001 | 0.625 | 1.879 | -0.606*** | -0.386*** | -0.023 | 0.000 | 0.744 |
| | High | 8.118*** | -0.373*** | -0.327*** | -0.204*** | -0.022*** | 0.594 | 3.938** | -0.580*** | -0.371*** | -0.200*** | 0.015 | 0.730 |
| | Low | 16.561*** | -0.763*** | -0.757*** | 0.362*** | 0.132*** | 0.732 | 1.000 | -0.689*** | -0.384*** | 0.298*** | 0.018 | 0.716 |
| | 2 | 12.069*** | -0.676*** | -0.624*** | 0.136*** | 0.083*** | 0.714 | 0.157 | -0.676*** | -0.331*** | 0.187*** | 0.005 | 0.727 |
| 2 | 3 | 7.066*** | -0.591*** | -0.482*** | -0.092*** | 0.094*** | 0.681 | -2.009 | -0.660*** | -0.311*** | 0.059*** | 0.003 | 0.728 |
| | 4 | 5.817*** | -0.531*** | -0.393*** | -0.227*** | 0.071*** | 0.637 | -1.452 | -0.683*** | -0.296*** | -0.058*** | 0.003 | 0.755 |
| | High | 7.572*** | -0.520*** | -0.356*** | -0.332*** | 0.042*** | 0.622 | -0.552 | -0.683*** | -0.370*** | -0.262*** | 0.016 | 0.750 |
| | Low | 10.303*** | -0.702*** | -0.574*** | 0.373*** | 0.056*** | 0.698 | 1.573 | -0.691*** | -0.226*** | 0.289*** | 0.039*** | 0.714 |
| | 2 | 7.679*** | -0.633*** | -0.474*** | 0.125*** | 0.088*** | 0.691 | 1.996 | -0.697*** | -0.135*** | 0.199*** | 0.017 | 0.734 |
| 3 | 3 | 6.042*** | -0.581*** | -0.365*** | -0.108*** | 0.071*** | 0.650 | 0.422 | -0.634*** | -0.174*** | 0.046*** | -0.002 | 0.734 |
| | 4 | 6.253*** | -0.539*** | -0.279*** | -0.291*** | 0.049*** | 0.620 | 1.431 | -0.660*** | -0.128*** | -0.044** | 0.011 | 0.755 |
| | High | 7.949*** | -0.555*** | -0.300*** | -0.369*** | 0.052*** | 0.627 | 0.453 | -0.664*** | -0.133*** | -0.239*** | -0.019 | 0.737 |
| | Low | 5.065* | -0.679*** | -0.392*** | 0.543*** | 0.138*** | 0.681 | 0.991 | -0.679*** | 0.009 | 0.231*** | 0.011 | 0.717 |
| | 2 | 3.865** | -0.613*** | -0.253*** | 0.088*** | 0.090*** | 0.664 | 1.213 | -0.655*** | 0.050*** | 0.179*** | 0.015 | 0.734 |
| 4 | 3 | 4.793*** | -0.563*** | -0.214*** | -0.189*** | 0.032*** | 0.635 | 1.035 | -0.649*** | 0.040** | 0.092*** | -0.004 | 0.731 |
| | 4 | 6.375*** | -0.533*** | -0.163*** | -0.309*** | 0.052*** | 0.615 | 2.488 | -0.680*** | 0.090*** | 0.006 | 0.011 | 0.737 |
| | High | 7.335*** | -0.523*** | -0.171*** | -0.345*** | 0.039*** | 0.607 | 1.374 | -0.695*** | 0.052*** | -0.239*** | 0.060*** | 0.752 |
| | Low | -3.594** | -0.460*** | 0.131*** | 0.482*** | 0.114*** | 0.706 | -0.849 | -0.609*** | 0.282*** | 0.271*** | 0.013 | 0.741 |
| | 2 | 1.073 | -0.587*** | 0.025** | -0.001 | 0.099*** | 0.685 | -1.433 | -0.603*** | 0.279*** | 0.156*** | -0.034*** | 0.759 |
| Big | 3 | 2.572* | -0.603*** | -0.019 | -0.185*** | 0.084*** | 0.659 | -0.349 | -0.668*** | 0.272*** | 0.069*** | 0.022** | 0.768 |
| | 4 | 3.468** | -0.568*** | 0.008 | -0.272*** | 0.061*** | 0.614 | -0.054 | -0.662*** | 0.278*** | -0.078*** | 0.032*** | 0.771 |
| | High | 5.045*** | -0.667*** | -0.038*** | -0.326*** | 0.099*** | 0.625 | 0.291 | -0.808*** | 0.244*** | -0.417*** | 0.089*** | 0.747 |

**Table 56: Subperiod Factor Regression Results for Equal Weighted Developed Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ |
| | Low | 10.965*** | -0.476*** | -0.569*** | 0.069*** | 0.067*** | 0.491 | 8.658*** | -0.465*** | -0.409*** | 0.180*** | 0.003 | 0.547 |
| | 2 | 9.750*** | -0.442*** | -0.498*** | 0.028* | 0.068*** | 0.498 | 9.425*** | -0.470*** | -0.380*** | 0.185*** | 0.025** | 0.545 |
| Small | 3 | 7.301*** | -0.386*** | -0.427*** | -0.040*** | 0.048*** | 0.489 | 7.863*** | -0.433*** | -0.344*** | 0.166*** | 0.027** | 0.548 |
| | 4 | 6.150*** | -0.336*** | -0.371*** | -0.103*** | 0.024*** | 0.446 | 7.598*** | -0.410*** | -0.327*** | 0.112*** | 0.023** | 0.566 |
| | High | 2.516*** | -0.235*** | -0.254*** | -0.108*** | 0.007 | 0.409 | 5.496*** | -0.329*** | -0.319*** | 0.036** | 0.011 | 0.501 |
| | Low | 14.445*** | -0.704*** | -0.637*** | 0.299*** | 0.166*** | 0.675 | 9.523*** | -0.683*** | -0.466*** | 0.422*** | 0.073*** | 0.692 |
| | 2 | 10.252*** | -0.603*** | -0.520*** | 0.161*** | 0.148*** | 0.659 | 8.127*** | -0.609*** | -0.366*** | 0.299*** | 0.074*** | 0.674 |
| 2 | 3 | 7.251*** | -0.515*** | -0.409*** | -0.016 | 0.095*** | 0.622 | 7.552*** | -0.609*** | -0.340*** | 0.212*** | 0.073*** | 0.693 |
| | 4 | 6.420*** | -0.461*** | -0.339*** | -0.137*** | 0.056*** | 0.572 | 7.380*** | -0.602*** | -0.335*** | 0.109*** | 0.079*** | 0.708 |
| | High | 7.547*** | -0.488*** | -0.368*** | -0.286*** | 0.050*** | 0.584 | 7.854*** | -0.590*** | -0.433*** | -0.066*** | 0.065*** | 0.694 |
| | Low | 9.434*** | -0.712*** | -0.549*** | 0.475*** | 0.232*** | 0.657 | 7.487*** | -0.676*** | -0.297*** | 0.413*** | 0.091*** | 0.703 |
| | 2 | 8.880*** | -0.650*** | -0.420*** | 0.169*** | 0.148*** | 0.654 | 7.788*** | -0.665*** | -0.280*** | 0.306*** | 0.074*** | 0.702 |
| 3 | 3 | 5.908*** | -0.559*** | -0.308*** | -0.079*** | 0.130*** | 0.593 | 6.786*** | -0.636*** | -0.209*** | 0.222*** | 0.109*** | 0.716 |
| | 4 | 6.778*** | -0.515*** | -0.261*** | -0.208*** | 0.071*** | 0.594 | 7.591*** | -0.646*** | -0.202*** | 0.136*** | 0.102*** | 0.724 |
| | High | 7.681*** | -0.536*** | -0.292*** | -0.335*** | 0.058*** | 0.591 | 7.902*** | -0.638*** | -0.264*** | -0.065*** | 0.087*** | 0.713 |
| | Low | 7.496*** | -0.701*** | -0.391*** | 0.435*** | 0.227*** | 0.656 | 6.038*** | -0.647*** | -0.096*** | 0.405*** | 0.088*** | 0.680 |
| | 2 | 5.426*** | -0.581*** | -0.270*** | 0.122*** | 0.158*** | 0.610 | 5.057*** | -0.604*** | -0.039* | 0.270*** | 0.049*** | 0.650 |
| 4 | 3 | 7.468*** | -0.585*** | -0.198*** | -0.183*** | 0.095*** | 0.629 | 6.039*** | -0.637*** | -0.111*** | 0.217*** | 0.079*** | 0.703 |
| | 4 | 6.387*** | -0.536*** | -0.180*** | -0.313*** | 0.067*** | 0.598 | 7.608*** | -0.647*** | -0.105*** | 0.110*** | 0.063*** | 0.712 |
| | High | 8.009*** | -0.562*** | -0.185*** | -0.374*** | 0.069*** | 0.599 | 7.769*** | -0.675*** | -0.073*** | -0.049* | 0.103*** | 0.711 |
| | Low | 2.223 | -0.598*** | -0.108*** | 0.558*** | 0.261*** | 0.683 | 4.042** | -0.590*** | 0.108*** | 0.420*** | 0.076*** | 0.714 |
| | 2 | 1.612 | -0.515*** | -0.021 | -0.083*** | 0.045*** | 0.545 | 4.458*** | -0.607*** | 0.145*** | 0.323*** | 0.048*** | 0.716 |
| Big | 3 | 4.254*** | -0.533*** | -0.006 | -0.243*** | 0.074*** | 0.619 | 5.215*** | -0.623*** | 0.088*** | 0.210*** | 0.078*** | 0.715 |
| | 4 | 4.858*** | -0.539*** | -0.005 | -0.303*** | 0.061*** | 0.601 | 5.732*** | -0.649*** | 0.162*** | 0.117*** | 0.099*** | 0.724 |
| | High | 5.165*** | -0.545*** | 0.003 | -0.283*** | 0.092*** | 0.589 | 2.271 | -0.647*** | 0.176*** | -0.090*** | 0.136*** | 0.665 |

**Table 57: Subperiod Factor Regression Results for Equal Weighted Developed excl. US Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* |
| | Low | 8.423*** | -0.445*** | -0.466*** | 0.212*** | 0.090*** | 0.516 | 6.610*** | -0.462*** | -0.338*** | 0.263*** | 0.032*** | 0.594 |
| | 2 | 6.961*** | -0.420*** | -0.432*** | 0.132*** | 0.061*** | 0.499 | 8.218*** | -0.477*** | -0.330*** | 0.275*** | 0.064*** | 0.604 |
| Small | 3 | 6.145*** | -0.402*** | -0.408*** | 0.019 | 0.049*** | 0.495 | 6.394*** | -0.438*** | -0.302*** | 0.229*** | 0.052*** | 0.578 |
| | 4 | 4.256*** | -0.343*** | -0.351*** | -0.029** | 0.027*** | 0.465 | 6.338*** | -0.415*** | -0.292*** | 0.186*** | 0.040*** | 0.590 |
| | High | 1.518 | -0.271*** | -0.285*** | -0.078*** | 0.008 | 0.429 | 4.012*** | -0.354*** | -0.304*** | 0.137*** | 0.036*** | 0.574 |
| | Low | 13.378*** | -0.623*** | -0.532*** | 0.351*** | 0.176*** | 0.654 | 9.644*** | -0.673*** | -0.508*** | 0.488*** | 0.106*** | 0.676 |
| | 2 | 8.822*** | -0.556*** | -0.498*** | 0.195*** | 0.142*** | 0.627 | 8.385*** | -0.617*** | -0.419*** | 0.320*** | 0.107*** | 0.667 |
| 2 | 3 | 6.771*** | -0.530*** | -0.465*** | -0.035** | 0.092*** | 0.592 | 7.978*** | -0.587*** | -0.409*** | 0.215*** | 0.075*** | 0.680 |
| | 4 | 6.004*** | -0.493*** | -0.431*** | -0.136*** | 0.071*** | 0.578 | 8.172*** | -0.575*** | -0.449*** | 0.125*** | 0.075*** | 0.686 |
| | High | 7.335*** | -0.544*** | -0.463*** | -0.269*** | 0.056*** | 0.580 | 6.865*** | -0.568*** | -0.532*** | 0.003 | 0.069*** | 0.673 |
| | Low | 8.747*** | -0.624*** | -0.445*** | 0.413*** | 0.169*** | 0.627 | 7.584*** | -0.656*** | -0.314*** | 0.443*** | 0.083*** | 0.691 |
| | 2 | 8.484*** | -0.581*** | -0.414*** | 0.078*** | 0.121*** | 0.625 | 7.312*** | -0.642*** | -0.294*** | 0.297*** | 0.126*** | 0.705 |
| 3 | 3 | 4.515*** | -0.547*** | -0.383*** | -0.058*** | 0.113*** | 0.560 | 6.774*** | -0.622*** | -0.282*** | 0.270*** | 0.111*** | 0.687 |
| | 4 | 5.092*** | -0.520*** | -0.342*** | -0.181*** | 0.067*** | 0.552 | 7.288*** | -0.618*** | -0.316*** | 0.159*** | 0.104*** | 0.703 |
| | High | 6.789*** | -0.549*** | -0.347*** | -0.254*** | 0.071*** | 0.576 | 7.536*** | -0.617*** | -0.371*** | -0.029 | 0.078*** | 0.695 |
| | Low | 9.209*** | -0.643*** | -0.312*** | 0.303*** | 0.166*** | 0.644 | 4.033** | -0.627*** | -0.144*** | 0.439*** | 0.102*** | 0.677 |
| | 2 | 4.269*** | -0.560*** | -0.286*** | 0.015 | 0.115*** | 0.600 | 5.408*** | -0.630*** | -0.157*** | 0.341*** | 0.110*** | 0.697 |
| 4 | 3 | 4.208*** | -0.531*** | -0.221*** | -0.189*** | 0.093*** | 0.570 | 5.185*** | -0.618*** | -0.171*** | 0.212*** | 0.117*** | 0.707 |
| | 4 | 4.119*** | -0.535*** | -0.240*** | -0.191*** | 0.084*** | 0.579 | 5.852*** | -0.624*** | -0.168*** | 0.154*** | 0.077*** | 0.712 |
| | High | 6.622*** | -0.571*** | -0.239*** | -0.274*** | 0.057*** | 0.593 | 8.879*** | -0.663*** | -0.204*** | -0.059** | 0.110*** | 0.709 |
| | Low | 2.151 | -0.564*** | -0.055*** | 0.445*** | 0.192*** | 0.654 | 3.373** | -0.577*** | -0.021 | 0.460*** | 0.109*** | 0.704 |
| | 2 | -1.902 | -0.435*** | 0.042*** | -0.077*** | 0.036*** | 0.523 | 2.142 | -0.541*** | 0.053*** | 0.323*** | 0.054*** | 0.643 |
| Big | 3 | 0.995 | -0.485*** | 0.048*** | -0.124*** | 0.105*** | 0.631 | 3.774** | -0.611*** | 0.043** | 0.274*** | 0.117*** | 0.711 |
| | 4 | 0.765 | -0.486*** | 0.058*** | -0.176*** | 0.082*** | 0.583 | 5.241*** | -0.616*** | 0.127*** | 0.119*** | 0.127*** | 0.721 |
| | High | 0.899 | -0.460*** | 0.084*** | -0.260*** | 0.088*** | 0.524 | -1.085 | -0.592*** | 0.193*** | 0.040 | 0.147*** | 0.629 |

**Table 58: Subperiod Factor Regression Results for Equal Weighted Japan Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* |
| | Low | 18.335*** | -0.524*** | -0.622*** | -0.060*** | 0.099*** | 0.601 | 6.608** | -0.607*** | -0.716*** | 0.294*** | 0.074*** | 0.641 |
| | 2 | 15.389*** | -0.466*** | -0.548*** | -0.077*** | 0.072*** | 0.587 | 4.216** | -0.519*** | -0.619*** | 0.132*** | 0.066*** | 0.635 |
| Small | 3 | 15.464*** | -0.449*** | -0.525*** | -0.116*** | 0.074*** | 0.597 | 2.488 | -0.474*** | -0.544*** | 0.067*** | 0.055*** | 0.632 |
| | 4 | 13.749*** | -0.431*** | -0.507*** | -0.114*** | 0.057*** | 0.591 | 2.087 | -0.472*** | -0.520*** | 0.031* | 0.061*** | 0.644 |
| | High | 13.728*** | -0.427*** | -0.485*** | -0.175*** | 0.058*** | 0.624 | 1.176 | -0.422*** | -0.474*** | -0.072*** | 0.037*** | 0.634 |
| | Low | 16.895*** | -0.619*** | -0.575*** | 0.177*** | 0.096*** | 0.625 | 4.871** | -0.679*** | -0.695*** | 0.378*** | 0.101*** | 0.706 |
| | 2 | 16.014*** | -0.609*** | -0.562*** | 0.046** | 0.121*** | 0.670 | 0.228 | -0.579*** | -0.534*** | 0.144*** | 0.106*** | 0.689 |
| 2 | 3 | 12.842*** | -0.565*** | -0.499*** | -0.099*** | 0.105*** | 0.668 | -0.626 | -0.588*** | -0.521*** | 0.029* | 0.091*** | 0.697 |
| | 4 | 10.630*** | -0.547*** | -0.472*** | -0.124*** | 0.112*** | 0.660 | -1.601 | -0.569*** | -0.472*** | 0.006 | 0.093*** | 0.688 |
| | High | 12.862*** | -0.578*** | -0.473*** | -0.264*** | 0.086*** | 0.688 | -2.569 | -0.589*** | -0.510*** | -0.146*** | 0.045*** | 0.709 |
| | Low | 15.845*** | -0.639*** | -0.478*** | 0.209*** | 0.102*** | 0.645 | 4.335* | -0.659*** | -0.550*** | 0.426*** | 0.091*** | 0.691 |
| | 2 | 9.216*** | -0.605*** | -0.402*** | 0.114*** | 0.097*** | 0.658 | -3.375 | -0.627*** | -0.397*** | 0.177*** | 0.139*** | 0.694 |
| 3 | 3 | 10.246*** | -0.598*** | -0.388*** | -0.079*** | 0.159*** | 0.674 | -3.613* | -0.603*** | -0.378*** | 0.099*** | 0.111*** | 0.688 |
| | 4 | 8.582*** | -0.567*** | -0.352*** | -0.186*** | 0.131*** | 0.662 | -5.973*** | -0.593*** | -0.407*** | -0.065*** | 0.045*** | 0.679 |
| | High | 9.798*** | -0.584*** | -0.361*** | -0.271*** | 0.089*** | 0.675 | -6.367*** | -0.593*** | -0.386*** | -0.178*** | 0.027** | 0.681 |
| | Low | 11.734*** | -0.635*** | -0.292*** | 0.211*** | 0.049*** | 0.672 | 0.015 | -0.639*** | -0.300*** | 0.453*** | 0.106*** | 0.689 |
| | 2 | 5.163** | -0.584*** | -0.208*** | 0.029 | 0.124*** | 0.645 | -7.224*** | -0.592*** | -0.215*** | 0.207*** | 0.114*** | 0.678 |
| 4 | 3 | 3.448 | -0.554*** | -0.166*** | -0.141*** | 0.122*** | 0.648 | -5.941*** | -0.605*** | -0.201*** | 0.085*** | 0.072*** | 0.702 |
| | 4 | 3.863* | -0.544*** | -0.177*** | -0.225*** | 0.100*** | 0.647 | -6.218*** | -0.601*** | -0.223*** | -0.024 | 0.060*** | 0.696 |
| | High | 7.060*** | -0.585*** | -0.227*** | -0.300*** | 0.137*** | 0.652 | -8.219*** | -0.609*** | -0.209*** | -0.175*** | 0.038*** | 0.684 |
| | Low | 5.431** | -0.598*** | -0.043** | 0.339*** | 0.098*** | 0.692 | -7.331*** | -0.599*** | 0.013 | 0.410*** | 0.084*** | 0.706 |
| | 2 | -0.143 | -0.525*** | 0.014 | 0.037** | 0.126*** | 0.682 | -7.662*** | -0.595*** | -0.012 | 0.206*** | 0.050*** | 0.710 |
| Big | 3 | 1.485 | -0.543*** | 0.004 | -0.139*** | 0.121*** | 0.674 | -8.125*** | -0.604*** | -0.001 | 0.115*** | 0.103*** | 0.709 |
| | 4 | 1.251 | -0.541*** | 0.004 | -0.205*** | 0.077*** | 0.656 | -7.669*** | -0.606*** | -0.051*** | -0.074*** | 0.015 | 0.704 |
| | High | 1.827 | -0.620*** | -0.010 | -0.356*** | 0.086*** | 0.613 | -7.537*** | -0.662*** | -0.084*** | -0.212*** | 0.095*** | 0.687 |

**Table 59: Subperiod Factor Regression Results for Equal Weighted Asia Pacific excl. Japan Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ |
| | Low | 7.786*** | -0.549*** | -0.480*** | 0.194*** | -0.003 | 0.385 | 5.928*** | -0.488*** | -0.420*** | 0.177*** | -0.062*** | 0.566 |
| | 2 | 9.343*** | -0.512*** | -0.452*** | 0.138*** | 0.017* | 0.426 | 7.645*** | -0.498*** | -0.386*** | 0.194*** | -0.013 | 0.567 |
| Small | 3 | 6.369*** | -0.490*** | -0.397*** | 0.123*** | -0.007 | 0.423 | 6.674*** | -0.474*** | -0.366*** | 0.149*** | -0.026* | 0.554 |
| | 4 | 5.280*** | -0.402*** | -0.335*** | 0.067*** | -0.009 | 0.441 | 5.842*** | -0.441*** | -0.359*** | 0.111*** | -0.014 | 0.563 |
| | High | 5.647*** | -0.341*** | -0.319*** | -0.009 | -0.009 | 0.450 | 5.616*** | -0.371*** | -0.301*** | 0.019 | -0.017* | 0.567 |
| | Low | 17.072*** | -0.675*** | -0.499*** | 0.197*** | 0.072*** | 0.533 | 18.101*** | -0.705*** | -0.662*** | 0.126*** | -0.096*** | 0.672 |
| | 2 | 13.969*** | -0.658*** | -0.496*** | 0.116*** | 0.095*** | 0.536 | 19.680*** | -0.712*** | -0.614*** | 0.139*** | -0.030* | 0.673 |
| 2 | 3 | 11.832*** | -0.596*** | -0.434*** | 0.055*** | 0.074*** | 0.542 | 15.681*** | -0.654*** | -0.578*** | 0.060*** | -0.066*** | 0.668 |
| | 4 | 13.591*** | -0.581*** | -0.423*** | -0.073*** | 0.004 | 0.555 | 16.190*** | -0.656*** | -0.510*** | -0.005 | -0.065*** | 0.681 |
| | High | 12.567*** | -0.558*** | -0.430*** | -0.202*** | 0.047*** | 0.473 | 16.343*** | -0.624*** | -0.534*** | -0.215*** | -0.090*** | 0.678 |
| | Low | 16.899*** | -0.688*** | -0.434*** | 0.245*** | 0.114*** | 0.545 | 17.636*** | -0.822*** | -0.573*** | 0.268*** | -0.132*** | 0.651 |
| | 2 | 9.757*** | -0.576*** | -0.363*** | 0.141*** | 0.028*** | 0.491 | 15.726*** | -0.750*** | -0.540*** | 0.126*** | -0.024 | 0.675 |
| 3 | 3 | 9.273*** | -0.518*** | -0.287*** | 0.063*** | -0.008 | 0.527 | 14.671*** | -0.733*** | -0.451*** | 0.090*** | -0.011 | 0.680 |
| | 4 | 9.467*** | -0.559*** | -0.334*** | -0.054*** | 0.069*** | 0.469 | 14.123*** | -0.636*** | -0.454*** | -0.014 | 0.033** | 0.587 |
| | High | 15.169*** | -0.625*** | -0.344*** | -0.202*** | 0.091*** | 0.519 | 14.526*** | -0.613*** | -0.441*** | -0.183*** | -0.085*** | 0.661 |
| | Low | 9.075*** | -0.569*** | -0.322*** | 0.139*** | 0.020* | 0.502 | 10.544*** | -0.714*** | -0.277*** | 0.218*** | -0.006 | 0.682 |
| | 2 | 6.026*** | -0.466*** | -0.183*** | 0.111*** | 0.016* | 0.511 | 11.247*** | -0.670*** | -0.232*** | 0.150*** | 0.038** | 0.653 |
| 4 | 3 | 5.261** | -0.542*** | -0.154*** | 0.200*** | -0.009 | 0.373 | 11.292*** | -0.647*** | -0.221*** | 0.119*** | 0.035** | 0.672 |
| | 4 | 8.647*** | -0.548*** | -0.236*** | 0.005 | 0.066*** | 0.531 | 10.817*** | -0.645*** | -0.254*** | 0.074*** | -0.005 | 0.671 |
| | High | 14.816*** | -0.631*** | -0.187*** | -0.184*** | 0.077*** | 0.544 | 12.027*** | -0.613*** | -0.258*** | -0.104*** | 0.008 | 0.624 |
| | Low | 8.817*** | -0.665*** | -0.085*** | 0.252*** | 0.055*** | 0.624 | 7.283*** | -0.624*** | 0.019 | 0.275*** | -0.030** | 0.699 |
| | 2 | 5.730*** | -0.548*** | -0.038** | 0.187*** | 0.036*** | 0.611 | 8.367*** | -0.630*** | 0.049** | 0.238*** | 0.009 | 0.685 |
| Big | 3 | 5.696*** | -0.602*** | -0.143*** | 0.103*** | 0.112*** | 0.605 | 7.155*** | -0.606*** | -0.020 | 0.106*** | -0.009 | 0.695 |
| | 4 | 8.399*** | -0.560*** | -0.012 | -0.095*** | 0.049*** | 0.585 | 9.198*** | -0.627*** | -0.016 | -0.051*** | -0.014 | 0.721 |
| | High | 13.842*** | -0.688*** | 0.077*** | -0.298*** | 0.104*** | 0.583 | 11.785*** | -0.630*** | -0.032* | -0.269*** | -0.050*** | 0.657 |

**Table 60: Subperiod Factor Regression Results for Equal Weighted Europe Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | *R2* |
| | Low | 7.655*** | -0.514*** | -0.530*** | 0.233*** | 0.106*** | 0.571 | 6.146*** | -0.398*** | -0.394*** | 0.154*** | 0.032*** | 0.555 |
| | 2 | 5.749*** | -0.494*** | -0.497*** | 0.150*** | 0.113*** | 0.578 | 7.721*** | -0.423*** | -0.401*** | 0.175*** | 0.059*** | 0.606 |
| Small | 3 | 5.312*** | -0.456*** | -0.452*** | 0.028** | 0.082*** | 0.572 | 6.336*** | -0.401*** | -0.376*** | 0.157*** | 0.050*** | 0.576 |
| | 4 | 3.485*** | -0.417*** | -0.415*** | -0.047*** | 0.057*** | 0.552 | 6.409*** | -0.391*** | -0.366*** | 0.121*** | 0.040*** | 0.578 |
| | High | 1.113 | -0.326*** | -0.339*** | -0.105*** | 0.024*** | 0.478 | 3.236** | -0.319*** | -0.294*** | 0.088*** | 0.030*** | 0.530 |
| | Low | 10.166*** | -0.615*** | -0.521*** | 0.390*** | 0.176*** | 0.633 | 5.308*** | -0.574*** | -0.414*** | 0.341*** | 0.114*** | 0.632 |
| | 2 | 7.070*** | -0.557*** | -0.497*** | 0.181*** | 0.148*** | 0.623 | 5.373*** | -0.553*** | -0.413*** | 0.229*** | 0.063*** | 0.601 |
| 2 | 3 | 4.438*** | -0.474*** | -0.418*** | -0.020 | 0.067*** | 0.563 | 7.391*** | -0.570*** | -0.418*** | 0.157*** | 0.075*** | 0.640 |
| | 4 | 3.450*** | -0.446*** | -0.397*** | -0.146*** | 0.043*** | 0.523 | 8.094*** | -0.552*** | -0.394*** | 0.114*** | 0.087*** | 0.666 |
| | High | 3.755*** | -0.443*** | -0.371*** | -0.182*** | 0.033*** | 0.527 | 8.404*** | -0.556*** | -0.387*** | -0.034* | 0.090*** | 0.681 |
| | Low | 5.218*** | -0.589*** | -0.414*** | 0.469*** | 0.184*** | 0.596 | 4.246** | -0.659*** | -0.337*** | 0.358*** | 0.097*** | 0.667 |
| | 2 | 5.641*** | -0.537*** | -0.393*** | 0.099*** | 0.115*** | 0.597 | 5.710*** | -0.676*** | -0.320*** | 0.310*** | 0.134*** | 0.694 |
| 3 | 3 | 2.791* | -0.464*** | -0.327*** | -0.153*** | 0.081*** | 0.512 | 7.321*** | -0.648*** | -0.334*** | 0.203*** | 0.118*** | 0.707 |
| | 4 | 3.119** | -0.471*** | -0.334*** | -0.151*** | 0.045*** | 0.521 | 6.273*** | -0.647*** | -0.361*** | 0.126*** | 0.116*** | 0.708 |
| | High | 4.442*** | -0.467*** | -0.304*** | -0.223*** | 0.039*** | 0.519 | 9.114*** | -0.640*** | -0.352*** | -0.120*** | 0.107*** | 0.697 |
| | Low | 0.057 | -0.545*** | -0.276*** | 0.446*** | 0.264*** | 0.573 | 0.910 | -0.611*** | -0.132*** | 0.408*** | 0.138*** | 0.650 |
| | 2 | 2.429 | -0.527*** | -0.267*** | 0.024 | 0.132*** | 0.563 | -1.527 | -0.569*** | -0.093*** | 0.307*** | 0.094*** | 0.576 |
| 4 | 3 | 1.666 | -0.494*** | -0.208*** | -0.100*** | 0.090*** | 0.508 | 0.412 | -0.629*** | -0.136*** | 0.231*** | 0.152*** | 0.686 |
| | 4 | 4.057*** | -0.520*** | -0.215*** | -0.207*** | 0.089*** | 0.574 | 4.756** | -0.652*** | -0.188*** | 0.158*** | 0.169*** | 0.687 |
| | High | 4.205*** | -0.478*** | -0.189*** | -0.268*** | 0.059*** | 0.527 | 5.880** | -0.692*** | -0.132*** | -0.085*** | 0.179*** | 0.692 |
| | Low | -0.170 | -0.540*** | 0.003 | 0.485*** | 0.222*** | 0.661 | -0.840 | -0.542*** | 0.114*** | 0.448*** | 0.102*** | 0.706 |
| | 2 | -6.189*** | -0.366*** | 0.069*** | -0.105*** | -0.009 | 0.416 | -0.080 | -0.568*** | 0.112*** | 0.369*** | 0.091*** | 0.701 |
| Big | 3 | -2.712 | -0.460*** | 0.056*** | -0.126*** | 0.134*** | 0.595 | 0.359 | -0.604*** | 0.096*** | 0.279*** | 0.152*** | 0.702 |
| | 4 | -1.687 | -0.481*** | 0.030** | -0.177*** | 0.114*** | 0.565 | 1.297 | -0.646*** | 0.120*** | 0.114*** | 0.181*** | 0.730 |
| | High | -0.300 | -0.486*** | 0.005 | -0.164*** | 0.118*** | 0.531 | -8.490*** | -0.568*** | 0.155*** | -0.002 | 0.203*** | 0.581 |

**Table 61: Subperiod Factor Regression Results for Equal Weighted North America Index**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | | 01 January 1991 to 31 December 2004 | | | | | | 03 January 2005 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ | $\alpha$ | $\beta m$ | $\beta s$ | $\beta h$ | $\beta u$ | $R2$ |
| | Low | 12.463*** | -0.467*** | -0.511*** | 0.052*** | 0.085*** | 0.508 | 6.527*** | -0.545*** | -0.336*** | 0.154*** | 0.011 | 0.615 |
| | 2 | 12.454*** | -0.465*** | -0.471*** | 0.015 | 0.108*** | 0.537 | 5.974** | -0.550*** | -0.288*** | 0.163*** | 0.033** | 0.629 |
| Small | 3 | 8.281*** | -0.398*** | -0.381*** | -0.053*** | 0.075*** | 0.524 | 5.027** | -0.511*** | -0.275*** | 0.101*** | 0.020 | 0.635 |
| | 4 | 6.571*** | -0.339*** | -0.317*** | -0.128*** | 0.043*** | 0.512 | 5.032** | -0.479*** | -0.266*** | 0.042** | 0.017 | 0.650 |
| | High | 3.396*** | -0.230*** | -0.208*** | -0.129*** | 0.007 | 0.417 | 5.578*** | -0.391*** | -0.190*** | -0.081*** | 0.034*** | 0.600 |
| | Low | 15.605*** | -0.755*** | -0.758*** | 0.367*** | 0.232*** | 0.693 | 2.028 | -0.711*** | -0.410*** | 0.333*** | 0.060*** | 0.710 |
| | 2 | 10.792*** | -0.648*** | -0.598*** | 0.169*** | 0.191*** | 0.677 | 0.785 | -0.684*** | -0.327*** | 0.217*** | 0.030** | 0.707 |
| 2 | 3 | 5.513*** | -0.564*** | -0.463*** | -0.056*** | 0.154*** | 0.647 | -0.935 | -0.690*** | -0.297*** | 0.083*** | 0.059*** | 0.727 |
| | 4 | 5.874*** | -0.524*** | -0.395*** | -0.216*** | 0.106*** | 0.618 | -0.832 | -0.698*** | -0.308*** | -0.028 | 0.039*** | 0.744 |
| | High | 7.182*** | -0.510*** | -0.349*** | -0.324*** | 0.067*** | 0.604 | 1.895 | -0.712*** | -0.361*** | -0.227*** | 0.082*** | 0.738 |
| | Low | 8.521*** | -0.672*** | -0.581*** | 0.466*** | 0.226*** | 0.670 | 2.102 | -0.711*** | -0.222*** | 0.333*** | 0.102*** | 0.702 |
| | 2 | 6.427*** | -0.626*** | -0.486*** | 0.185*** | 0.193*** | 0.652 | 2.770 | -0.720*** | -0.139*** | 0.230*** | 0.054*** | 0.725 |
| 3 | 3 | 5.172*** | -0.561*** | -0.357*** | -0.036** | 0.159*** | 0.631 | 1.482 | -0.661*** | -0.166*** | 0.077*** | 0.058*** | 0.726 |
| | 4 | 5.153*** | -0.545*** | -0.299*** | -0.268*** | 0.089*** | 0.577 | 3.041 | -0.680*** | -0.122*** | -0.004 | 0.073*** | 0.746 |
| | High | 7.720*** | -0.558*** | -0.293*** | -0.358*** | 0.090*** | 0.624 | 2.382 | -0.698*** | -0.130*** | -0.211*** | 0.061*** | 0.728 |
| | Low | 4.017 | -0.665*** | -0.416*** | 0.605*** | 0.313*** | 0.659 | 1.854 | -0.713*** | -0.001 | 0.263*** | 0.071*** | 0.712 |
| | 2 | 2.811 | -0.596*** | -0.285*** | 0.174*** | 0.177*** | 0.650 | 1.648 | -0.696*** | 0.063*** | 0.206*** | 0.076*** | 0.721 |
| 4 | 3 | 4.556*** | -0.560*** | -0.209*** | -0.160*** | 0.110*** | 0.627 | 1.967 | -0.674*** | 0.036** | 0.113*** | 0.039*** | 0.730 |
| | 4 | 6.678*** | -0.530*** | -0.172*** | -0.308*** | 0.091*** | 0.596 | 3.003 | -0.691*** | 0.093*** | 0.039** | 0.056*** | 0.721 |
| | High | 7.825*** | -0.546*** | -0.193*** | -0.365*** | 0.076*** | 0.603 | 2.305 | -0.722*** | 0.060*** | -0.181*** | 0.127*** | 0.723 |
| | Low | -4.654** | -0.509*** | -0.055*** | 0.623*** | 0.296*** | 0.692 | -0.508 | -0.681*** | 0.228*** | 0.277*** | 0.066*** | 0.746 |
| | 2 | 1.422 | -0.592*** | -0.078*** | 0.002 | 0.163*** | 0.685 | 0.582 | -0.697*** | 0.234*** | 0.178*** | 0.031*** | 0.756 |
| Big | 3 | 3.936** | -0.596*** | -0.069*** | -0.169*** | 0.119*** | 0.663 | 1.058 | -0.697*** | 0.225*** | 0.102*** | 0.037*** | 0.751 |
| | 4 | 4.516*** | -0.542*** | -0.027** | -0.296*** | 0.080*** | 0.611 | 0.745 | -0.690*** | 0.260*** | -0.005 | 0.057*** | 0.745 |
| | High | 5.788*** | -0.611*** | -0.050*** | -0.313*** | 0.132*** | 0.617 | 1.444 | -0.770*** | 0.230*** | -0.260*** | 0.123*** | 0.742 |

The most interesting result, complementing the findings from Section 2.3 and 2.4, is the performance of the Asia Pacific excluding Japan Index. The performance appears to increase for the second time horizon, with both subperiods containing positive statistically significant alphas for all quintiles. The results are more robust for value weighted.

While not reported, the *BETC* for the aforementioned results all follow the same trend. For alphas that decreased (increased) in the second time horizon, there is a lower (higher) *BETC* and thus the MA is less (more) likely to achieve positive excess returns after-cost relative to the BH. Thus, investors were better off using the MA in the Asia Pacific excluding Japan Index from January 3, 2005 to October 31, 2018. This was also the case for the January 1, 1991 to December 31, 2004.

After reviewing the results from Section 2.6 it is clear the MA can be an effective means of achieving returns in excess of the BH. However, excluding the Asia Pacific excluding Japan Index, there does appear to be a decline in its effectiveness through time.

## 2.7 Conclusion

As discussed in Section 1.3 and Section 1.4, Technical Analysis, specifically the MA, has been shown to outperform the BH. However, as stated previously questions arise as to whether this effectiveness can be maintained post transaction costs. Additionally, the research to date has primarily focused on the US market. Given the size and popularity of the US market for investments globally, it is not unreasonable to assume overall it is the most efficiently priced market in comparison to other markets. As a result, is it possible the MA relative to the BH can have a greater effect on performance in smaller (relative to the US) markets?

As shown and discussed in the previous sections, the North America Index, which comprises the US and Canada markets, does not have superior performance to other market indices. It is in fact one of the worst performing indices, especially in the last decade. In contrast, the Asia Pacific excluding Japan Index, which is comprised of the Australian, Hong Kong, New Zealand and Singapore markets, has consistently the highest positive statistically significant excess returns, irrespective of time horizon. In fact, it is the only index to see an increase in MA performance in the last decade. When reviewing these contrasting results, the question becomes, what is driving this disparity?

An argument can be made to the efficiency of the US market in particular being higher relative to many other developed markets. Its sheer size and volume traded has a significant effect on overall market efficiency. Additionally, many large-cap stocks in other markets would be considered mid-cap at best in the US. Consequently, it may be possible we are seeing a more pronounced effect of performance relative to size across quintiles in smaller markets. The bigger size quintiles in these markets are not actually large-cap relative to the US, as is likely the case for the Asia Pacific excluding Japan Index.

Furthermore, the Asia Pacific excluding Japan Index performance has a higher correlation to emerging markets in the Asia region which has seen significant positive market performance in the last two decades. There is also larger investor information asymmetry in markets with lower investor participation, which could also be a cause of the performance disparity.

A potential avenue of future research is to analyse the Asia Pacific excluding Japan region in more detail, analysing and comparing its inter-regional MA performance. The MA and its effectiveness in emerging markets could also be researched and compared to the developed markets performance to determine if MA positive performance is diminishing in developed relative to emerging.

In relation to value versus equal weighted and its effect on MA performance, the clear winner is value, with superior performance across the majority of quintiles. This is especially true when considering after-cost performance. The size of the quintile and its book-to-market also alter the performance of the MA. In almost all cases there is a negative relationship between size and performance, although it is less pronounced and more inconsistent for equal weighted. This is likely due to higher weights in larger firms within each size category reducing overall performance for the smallest quintiles in particular. Book-to-market is an interesting fundamental with respect to the MA. It appears to be negatively related to performance for the smallest sized quintiles, at times reversing to a positive relationship for the biggest size quintiles. At times it also appears to show a performance smile/smirk, with higher values for the lowest and highest book-to-market values within each size category. Overall, there is insufficient evidence from the above results to determine whether the aforementioned relationship between performance and book-to-market is universal for the MA given the inconsistencies across results.

The effectiveness of the MA appears to be persistent through time for smaller markets. The ability to generate a positive excess return all but disappeared in the last fourteen years for the North America and Japan Indices in particular, with only the smallest quintiles able to achieve a positive alpha. However, the overall Developed Index has been able to consistently generate a positive excess return with little change through time. This is largely due to the increase in performance for the Asia Pacific excluding Japan Index.

The most important result observed in Section 2 is the significant risk reducing benefits of the MA, irrespective of fundamentals, weighting method and market region. This finding is fundamental to understanding the MA. As a future performance predictor, the MA smooths out both wins and losses. While the results above show bigger sized quintiles in particular fail to outperform the BH after-cost, the risk reducing benefits are still very large and appear substantial irrespective of performance. Given the results indicate the MA is correct over 50% of the time in predicting future price movements in either direction, even if an investor does not want to actively trade using the MA, it can still be used at any given point in time should a buy/sell be required. Over time, even using it sporadically, it would still decrease an investors standard deviation of returns, and as has been shown above, likely increase an investor overall return especially when focused on smaller sized quintiles.

The above analysis highlights the effectiveness of the MA and its ability to achieve performance benefits for investors relative to the BH. Subsequent sections will focus on and analyse other aspects of the MA and its performance.

# 3.0 US Industry Portfolios and the Moving Average

## 3.1 Introduction

Past research discussed in Section 1.3 and 1.4 and the findings reported and analysed in Section 2 all show Technical Analysis through the Moving Average (MA) is an effective means of achieving returns in excess of a Buy-and-Hold (BH) strategy. The previous research has focused on overall market indices.

Section 3 will focus research on the MA and how different industry portfolios within the US market perform relative to the BH. The focus on the US Industries is a result of the US performance via the North America Index in Section 2. The results reported positive statistically significant abnormal returns diminishing to almost non-existent over the last three decades. By analysing the US markets for a longer time horizon, the performance of the MA for the US market across industries and through time can be analysed.

The Industry indices used can be seen in Section 3.2, Table 62. Value weighted and equal weighted results will also be analysed and compared.

## 3.2 US Industry Portfolio Data

The data used in this section relates to 49 Industry indices for the US market. Refer to Table 62 for a detailed list of each Industry index abbreviation and corresponding meaning.

**Table 62: List of Abbreviations for Industry Indices**

| | | | | | |
|---|---|---|---|---|---|
| ***Agric*** | *Agriculture* | ***Food*** | *Food Products* | ***Soda*** | *Candy & Soda* |
| ***Beer*** | *Beer & Liquor* | ***Smoke*** | *Tobacco Products* | ***Toys*** | *Recreation* |
| ***Fun*** | *Entertainment* | ***Books*** | *Printing and Publishing* | ***Hshld*** | *Consumer Goods* |
| ***Clths*** | *Apparel* | ***Hlth*** | *Healthcare* | ***MedEq*** | *Medical Equipment* |
| ***Drugs*** | *Pharmaceutical* | ***Chems*** | *Chemicals* | ***Rubbr*** | *Rubber and Plastic* |
| ***Txtls*** | *Textiles* | ***BldMt*** | *Construction Materials* | ***Cnstr*** | *Construction* |
| ***Steel*** | *Steel Works* | ***FabPr*** | *Fabricated Products* | ***Mach*** | *Machinery* |
| ***ElcEq*** | *Electrical Equipment* | ***Autos*** | *Automobiles & Trucks* | ***Aero*** | *Aircraft* |
| ***Ships*** | *Shipbuilding & Railroad* | ***Guns*** | *Defence* | ***Gold*** | *Precious Metals* |
| ***Mines*** | *(non)Metal Mining* | ***Coal*** | *Coal* | ***Oil*** | *Petroleum & Gas* |
| ***Util*** | *Utilities* | ***Telcm*** | *Telecommunications* | ***PerSv*** | *Personal Services* |
| ***BusSv*** | *Business Services* | ***Hardw*** | *Computers* | ***Softw*** | *Computer Software* |
| ***Chips*** | *Electronic Equipment* | ***LabEq*** | *Measuring & Control* | ***Paper*** | *Business Supplies* |
| ***Boxes*** | *Shipping Containers* | ***Trans*** | *Transportation* | ***Whlsl*** | *Wholesale Business* |
| ***Rtail*** | *Retail Business* | ***Meals*** | *Dining, Hotels & Motels* | ***Banks*** | *Banking* |
| ***Insur*** | *Insurance* | ***RlEst*** | *Real Estate* | ***Fin*** | *Trading* |
| ***Other*** | *Anything Else* | | | | |

The data was sourced from the Kenneth R. French Data Library. A detailed list of SIC codes for each index is accessible through the Data Library. The sourced data contained a time horizon of July 1, 1926 to October 31, 2018. However, not all indices covered the entire time horizon. To ensure all indices were analysed over the same time period, a truncated time horizon was chosen. The time horizon for the data used in Section 3 is July 1, 1969 to October 31, 2018 with daily returns used.

Using the aforementioned data, the CMA and TIS are determined as per Section 1.5 for each index and is completed twice, for both value and equal weighted portfolios. Once the TIS for each index is created, regression analysis is performed following the methodology in Section 1.6. The factors used in the regression models are all sourced from the Kenneth R. French Data Library.

The CMA and corresponding TIS in Section 3 corresponds to [*f, d, h*] values [*0, 0, 0*] where *f* is the fixed percentage difference, *d* is the fixed number of days crossed and *h* is the minimum number of days held. Changes in the MA indicator variables [*f, d, h*] and its effect on profitability will be analysed in Section 5.

The results for value and equal weighted are examined and compared. Section 3.3 contains the value weighted results. Section 3.4 contains the equal weighted results. Section 3.5 compares the results of both weighting methods. Section 3.6 contains the robustness check, separating the time horizon into two subperiods, July 1, 1969 to June 30, 1995 and July 1, 1995 to October 31, 2018.

## 3.3 Value Weighted Results

The regression results reported and analysed in this section correspond to the value weighted indices. A value weighted index is created by weighting each asset taking the market capitalisation of the individual asset and dividing it by the total market capitalisation of all assets in the index.

### 3.3.1 Summary Statistics

Table 63 contains the summary statistics for the value weighted US Industry indices. The table contains five statistics for the BH, MA and TIS: the mean return ($\mu$), standard deviation of returns ($\sigma$), skewness ($s$), kurtosis ($k$) and the Sharpe Ratio ($SR$). The statistics for the BH, MA and TIS are reported for each Industry index. Each index in Section 3 will be referred to by its abbreviation as per Table 62.

The first indication the MA is superior to the BH is the considerable success in its risk reducing benefits, with the standard deviation of returns decreasing and the $SR$ increasing for all indices. However, not all indices appear to generate a higher return for the MA over the BH.

There appear to be two clear standout indices with respect to the TIS portfolio, *RlEst* and *Hlth*. Both returning mean excess returns of over 9%. However, it does appear the MA outperforming BH is not universal, with several indices exhibiting negative mean excess returns.

Overall, the summary statistics show mixed performance results when using the MA across the Industry indices. Determining if the difference in performance is statistically significant takes place in Section 3.3.2.

**Table 62: Summary Statistics for Value Weighted US Portfolios by Industry**

Value Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | BH | | | | | MA | | | | | TIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| *Agric* | 12.12 | 22.21 | 0.37 | 17.66 | 0.34 | 11.34 | 13.35 | 0.17 | 14.12 | 0.51 | -0.78 | 14.00 | -0.36 | 43.19 | -0.06 |
| *Food* | 12.70 | 14.52 | -0.39 | 17.37 | 0.56 | 11.64 | 8.94 | 0.12 | 9.21 | 0.79 | -1.06 | 9.14 | 1.07 | 78.15 | -0.12 |
| *Soda* | 13.29 | 22.53 | -0.29 | 13.82 | 0.39 | 10.92 | 14.01 | -0.59 | 28.66 | 0.45 | -2.37 | 14.12 | 0.45 | 40.20 | -0.17 |
| *Beer* | 13.39 | 18.13 | -0.06 | 9.84 | 0.49 | 11.10 | 11.37 | 0.13 | 8.54 | 0.57 | -2.29 | 11.24 | 0.21 | 41.83 | -0.20 |
| *Smoke* | 17.25 | 22.17 | -0.09 | 13.08 | 0.57 | 13.81 | 13.98 | 0.08 | 13.55 | 0.66 | -3.44 | 13.44 | -0.07 | 39.47 | -0.26 |
| *Toys* | 8.65 | 23.42 | -0.34 | 10.03 | 0.17 | 12.14 | 13.56 | 0.01 | 10.77 | 0.56 | 3.49 | 15.68 | 1.15 | 33.66 | 0.22 |
| *Fun* | 15.46 | 26.35 | -0.29 | 13.52 | 0.41 | 17.74 | 14.83 | 0.01 | 9.33 | 0.89 | 2.28 | 17.95 | 0.72 | 44.11 | 0.13 |
| *Books* | 9.85 | 19.06 | -0.05 | 21.45 | 0.28 | 14.20 | 10.72 | -0.09 | 11.61 | 0.90 | 4.35 | 13.00 | 0.21 | 65.26 | 0.33 |
| *Hshld* | 10.11 | 17.27 | -0.83 | 25.76 | 0.32 | 8.98 | 10.08 | 0.04 | 7.56 | 0.44 | -1.13 | 11.59 | 2.53 | 110.90 | -0.10 |
| *Clths* | 11.67 | 20.06 | -0.25 | 12.66 | 0.35 | 16.62 | 11.74 | -0.02 | 8.46 | 1.03 | 4.95 | 13.16 | 0.68 | 44.59 | 0.38 |
| *Hlth* | 10.97 | 24.00 | -0.20 | 12.94 | 0.27 | 20.02 | 13.40 | 0.52 | 11.43 | 1.15 | 9.05 | 16.41 | 0.94 | 33.81 | 0.55 |
| *MedEq* | 12.53 | 18.69 | -0.27 | 9.57 | 0.43 | 12.30 | 11.03 | -0.12 | 6.32 | 0.70 | -0.23 | 12.29 | 0.56 | 35.12 | -0.02 |
| *Drugs* | 12.95 | 18.20 | -0.33 | 13.28 | 0.46 | 11.80 | 10.88 | -0.16 | 7.82 | 0.67 | -1.15 | 11.72 | 0.75 | 55.32 | -0.10 |
| *Chems* | 12.08 | 19.70 | -0.39 | 13.41 | 0.38 | 13.44 | 11.36 | 0.00 | 8.07 | 0.78 | 1.36 | 13.21 | 0.95 | 48.14 | 0.10 |
| *Rubbr* | 11.21 | 18.16 | -0.45 | 12.09 | 0.37 | 14.48 | 10.50 | -0.17 | 8.89 | 0.94 | 3.27 | 12.10 | 1.20 | 40.36 | 0.27 |
| *Txtls* | 10.11 | 21.72 | -0.06 | 22.02 | 0.25 | 16.95 | 12.19 | 1.04 | 27.43 | 1.02 | 6.85 | 14.75 | 1.25 | 57.87 | 0.46 |
| *BldMt* | 11.14 | 19.31 | -0.32 | 13.04 | 0.34 | 15.27 | 11.03 | -0.04 | 9.40 | 0.97 | 4.12 | 12.85 | 0.88 | 41.34 | 0.32 |
| *Cnstr* | 10.42 | 24.95 | -0.13 | 10.20 | 0.23 | 14.75 | 14.11 | -0.14 | 10.53 | 0.72 | 4.33 | 16.72 | 0.27 | 28.03 | 0.26 |
| *Steel* | 8.65 | 25.79 | -0.31 | 17.00 | 0.16 | 14.35 | 14.14 | 0.01 | 11.07 | 0.69 | 5.70 | 17.77 | 0.32 | 45.05 | 0.32 |
| *FabPr* | 8.61 | 23.77 | -0.13 | 9.21 | 0.17 | 14.15 | 13.69 | 0.20 | 10.57 | 0.70 | 5.54 | 15.67 | 0.45 | 20.86 | 0.35 |
| *Mach* | 11.03 | 20.72 | -0.31 | 13.64 | 0.31 | 15.24 | 11.59 | -0.10 | 8.63 | 0.92 | 4.21 | 14.01 | 0.45 | 36.67 | 0.30 |
| *ElcEq* | 13.22 | 21.86 | -0.25 | 12.13 | 0.40 | 13.46 | 12.64 | 0.09 | 7.34 | 0.70 | 0.24 | 14.42 | 0.58 | 42.85 | 0.02 |
| *Autos* | 9.53 | 23.10 | -0.19 | 11.44 | 0.21 | 13.09 | 13.13 | 0.18 | 10.02 | 0.65 | 3.56 | 15.51 | 0.81 | 34.77 | 0.23 |
| *Aero* | 13.89 | 21.31 | -0.36 | 12.37 | 0.44 | 16.44 | 12.59 | 0.21 | 8.59 | 0.94 | 2.55 | 14.01 | 1.16 | 48.62 | 0.18 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ships* | 12.52 | 23.77 | -0.13 | 6.93 | 0.33 | 14.57 | 14.81 | 0.02 | 10.56 | 0.68 | 2.05 | 14.71 | 0.71 | 20.94 | 0.14 |
| *Guns* | 14.93 | 21.76 | -0.16 | 11.71 | 0.48 | 13.36 | 13.66 | 0.23 | 10.29 | 0.64 | -1.57 | 13.33 | 1.17 | 43.93 | -0.12 |
| *Gold* | 10.10 | 37.22 | 0.41 | 9.54 | 0.15 | 9.28 | 22.13 | 0.70 | 14.91 | 0.21 | -0.82 | 24.00 | -0.76 | 25.19 | -0.03 |
| *Mines* | 11.00 | 25.68 | 0.04 | 14.17 | 0.25 | 15.54 | 14.61 | 0.25 | 10.38 | 0.75 | 4.54 | 17.21 | -0.28 | 45.34 | 0.26 |
| *Coal* | 12.89 | 37.79 | 0.01 | 10.59 | 0.22 | 15.41 | 21.72 | 0.29 | 11.73 | 0.50 | 2.52 | 25.25 | -0.05 | 29.19 | 0.10 |
| *Oil* | 12.16 | 21.46 | -0.18 | 16.52 | 0.35 | 10.46 | 12.58 | -0.12 | 7.24 | 0.47 | -1.70 | 14.16 | -0.11 | 64.88 | -0.12 |
| *Util* | 10.47 | 13.79 | -0.01 | 23.79 | 0.43 | 12.42 | 8.03 | -0.19 | 9.44 | 0.98 | 1.95 | 9.29 | -0.78 | 92.99 | 0.21 |
| *Telcm* | 11.16 | 17.65 | -0.11 | 16.32 | 0.37 | 10.55 | 10.14 | 0.00 | 8.69 | 0.59 | -0.61 | 11.78 | -0.48 | 49.69 | -0.05 |
| *PerSv* | 6.91 | 20.75 | -0.44 | 9.15 | 0.11 | 12.69 | 11.63 | -0.40 | 9.99 | 0.70 | 5.78 | 14.18 | 0.83 | 25.91 | 0.41 |
| *BusSv* | 10.81 | 17.59 | -0.54 | 12.38 | 0.35 | 15.83 | 9.60 | -0.18 | 7.35 | 1.17 | 5.02 | 12.24 | 1.19 | 39.07 | 0.41 |
| *Hardw* | 11.04 | 26.12 | 0.20 | 13.02 | 0.25 | 11.53 | 14.42 | -0.02 | 7.50 | 0.48 | 0.50 | 17.96 | -0.75 | 43.24 | 0.03 |
| *Softw* | 11.53 | 35.06 | 0.47 | 15.36 | 0.20 | 15.52 | 18.48 | 1.21 | 25.95 | 0.59 | 4.00 | 25.07 | -0.33 | 32.08 | 0.16 |
| *Chips* | 12.36 | 25.27 | 0.11 | 10.18 | 0.31 | 15.86 | 13.96 | 0.03 | 8.43 | 0.81 | 3.49 | 17.36 | -0.66 | 26.40 | 0.20 |
| *LabEq* | 11.86 | 22.58 | -0.19 | 9.49 | 0.32 | 15.91 | 12.88 | 0.11 | 8.39 | 0.88 | 4.05 | 15.16 | 0.47 | 30.07 | 0.27 |
| *Paper* | 11.15 | 17.59 | -0.58 | 17.12 | 0.37 | 14.13 | 10.37 | 0.13 | 8.51 | 0.92 | 2.98 | 11.59 | 1.76 | 71.63 | 0.26 |
| *Boxes* | 11.47 | 20.15 | -0.49 | 14.17 | 0.34 | 11.46 | 12.06 | -0.24 | 10.52 | 0.57 | -0.01 | 12.99 | 0.78 | 37.94 | 0.00 |
| *Trans* | 11.39 | 19.61 | -0.36 | 11.21 | 0.35 | 14.26 | 11.46 | 0.11 | 7.30 | 0.85 | 2.88 | 12.91 | 1.30 | 42.04 | 0.22 |
| *Whlsl* | 10.64 | 16.74 | -0.31 | 10.34 | 0.36 | 14.99 | 9.62 | -0.12 | 8.83 | 1.08 | 4.35 | 11.23 | 0.74 | 34.00 | 0.39 |
| *Rtail* | 12.63 | 18.43 | -0.21 | 13.29 | 0.44 | 13.96 | 10.70 | 0.08 | 8.24 | 0.88 | 1.33 | 12.28 | 0.47 | 48.94 | 0.11 |
| *Meals* | 12.16 | 19.93 | -0.18 | 9.84 | 0.38 | 14.52 | 11.47 | 0.07 | 6.73 | 0.87 | 2.35 | 13.39 | 0.44 | 33.03 | 0.18 |
| *Banks* | 11.91 | 22.63 | 0.32 | 23.70 | 0.32 | 13.90 | 12.10 | -0.48 | 24.48 | 0.77 | 1.98 | 15.82 | -0.96 | 57.08 | 0.13 |
| *Insur* | 12.46 | 18.37 | -0.04 | 19.42 | 0.43 | 15.45 | 10.09 | -0.14 | 9.36 | 1.08 | 2.99 | 12.77 | -0.15 | 61.76 | 0.23 |
| *RlEst* | 4.89 | 23.83 | 0.29 | 20.08 | 0.01 | 14.43 | 12.36 | 0.21 | 15.54 | 0.80 | 9.54 | 17.08 | -0.85 | 52.71 | 0.56 |
| *Fin* | 13.17 | 23.12 | 0.21 | 18.51 | 0.37 | 16.25 | 12.33 | -0.06 | 14.10 | 0.95 | 3.07 | 16.29 | -1.01 | 48.49 | 0.19 |
| *Other* | 5.14 | 22.47 | -0.17 | 14.72 | 0.03 | 10.95 | 11.50 | -0.60 | 22.51 | 0.56 | 5.81 | 16.33 | -0.01 | 33.09 | 0.36 |

### 3.3.2 Factor Regression Analysis

The regression analysis was performed using model (1), (2) and (3) from Section 1.6 although only model (3) will be reported and analysed as the other results do not alter nor add anything to the analysis.

Table 64 contains the results when regressing the TIS excess returns using the Carhart 4-factor model. Statistical significance tests were performed at the 90%, 95% and 99% confidence level, corresponding to *, ** and *** respectively.

**Table 64: Factor Regression Results for Value Weighted US Portfolios by Industry**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where $f$ is the fixed percentage difference, $d$ is the fixed number of days crossed and $h$ is the minimum number of days held.

| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|
| *Agric* | 2.614 | -0.452*** | -0.146*** | -0.075*** | -0.015 | 0.258 |
| *Food* | 1.600 | -0.365*** | 0.107*** | -0.037*** | -0.035*** | 0.426 |
| *Soda* | 0.415 | -0.434*** | 0.186*** | 0.011 | -0.026*** | 0.271 |
| *Beer* | 0.112 | -0.364*** | 0.185*** | 0.043*** | -0.051*** | 0.314 |
| *Smoke* | -1.190 | -0.354*** | 0.167*** | 0.025* | -0.028*** | 0.204 |
| *Toys* | 7.078*** | -0.619*** | -0.153*** | 0.056*** | 0.031*** | 0.414 |
| *Fun* | 6.245*** | -0.745*** | -0.165*** | -0.027* | 0.134*** | 0.463 |
| *Books* | 8.767*** | -0.600*** | -0.158*** | -0.192*** | 0.038*** | 0.533 |
| *Hshld* | 1.453 | -0.450*** | 0.210*** | 0.052*** | -0.010 | 0.449 |
| *Clths* | 8.800*** | -0.573*** | -0.195*** | -0.084*** | 0.036*** | 0.483 |
| *Hlth* | 12.236*** | -0.557*** | -0.195*** | 0.100*** | 0.012 | 0.313 |
| *MedEq* | 2.604** | -0.500*** | -0.011 | 0.114*** | -0.014* | 0.456 |
| *Drugs* | 1.389 | -0.471*** | 0.117*** | 0.144*** | -0.027*** | 0.475 |
| *Chems* | 5.539*** | -0.608*** | 0.004 | -0.123*** | 0.024*** | 0.540 |
| *Rubbr* | 7.656*** | -0.547*** | -0.291*** | -0.170*** | -0.003 | 0.514 |
| *Txtls* | 11.566*** | -0.618*** | -0.324*** | -0.295*** | 0.084*** | 0.459 |
| *BldMt* | 8.906*** | -0.618*** | -0.186*** | -0.215*** | 0.019*** | 0.572 |
| *Cnstr* | 10.466*** | -0.781*** | -0.331*** | -0.257*** | 0.014 | 0.543 |
| *Steel* | 11.150*** | -0.825*** | -0.252*** | -0.173*** | 0.090*** | 0.553 |
| *FabPr* | 9.782*** | -0.624*** | -0.400*** | -0.170*** | 0.093*** | 0.428 |
| *Mach* | 8.067*** | -0.677*** | -0.173*** | -0.020* | 0.087*** | 0.618 |
| *ElcEq* | 4.161*** | -0.670*** | -0.069*** | -0.001 | 0.052*** | 0.568 |
| *Autos* | 8.522*** | -0.711*** | -0.018 | -0.251*** | 0.079*** | 0.543 |
| *Aero* | 6.250*** | -0.599*** | -0.001 | -0.051*** | 0.042*** | 0.477 |
| *Ships* | 6.289*** | -0.511*** | -0.148*** | -0.169*** | -0.027** | 0.293 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Guns* | 1.785 | -0.411*** | 0.050*** | -0.079*** | -0.061*** | 0.239 |
| *Gold* | *1.026* | *-0.281**** | *-0.240**** | *0.034* | *-0.004* | *0.040* |
| *Mines* | 9.825*** | -0.690*** | -0.197*** | -0.230*** | 0.022* | 0.398 |
| *Coal* | 8.429*** | -0.822*** | -0.386*** | -0.266*** | 0.088*** | 0.272 |
| *Oil* | 2.448 | -0.566*** | 0.096*** | -0.150*** | -0.001 | 0.414 |
| *Util* | 4.991*** | -0.352*** | 0.071*** | -0.162*** | -0.026*** | 0.367 |
| *Telcm* | 2.493** | -0.514*** | 0.091*** | -0.091*** | 0.062*** | 0.516 |
| *PerSv* | 9.611*** | -0.583*** | -0.270*** | 0.018 | 0.000 | 0.444 |
| *BusSv* | 8.675*** | -0.601*** | -0.206*** | 0.032*** | 0.024*** | 0.635 |
| *Hardw* | 1.145 | -0.684*** | 0.063*** | 0.512*** | 0.214*** | 0.526 |
| *Softw* | 6.201** | -0.753*** | -0.283*** | 0.475*** | 0.116*** | 0.297 |
| *Chips* | 4.831*** | -0.719*** | -0.141*** | 0.445*** | 0.206*** | 0.576 |
| *LabEq* | 6.471*** | -0.660*** | -0.149*** | 0.262*** | 0.111*** | 0.568 |
| *Paper* | 6.857*** | -0.528*** | 0.001 | -0.143*** | 0.008 | 0.524 |
| *Boxes* | 3.985*** | -0.558*** | -0.044*** | -0.107*** | 0.002 | 0.462 |
| *Trans* | 6.993*** | -0.601*** | -0.132*** | -0.103*** | 0.029*** | 0.548 |
| *Whlsl* | 7.670*** | -0.524*** | -0.181*** | -0.014 | 0.027*** | 0.565 |
| *Rtail* | 4.680*** | -0.543*** | 0.023** | 0.040*** | -0.009 | 0.520 |
| *Meals* | 5.214*** | -0.526*** | -0.001 | 0.085*** | 0.020** | 0.423 |
| *Banks* | 7.737*** | -0.738*** | -0.035*** | -0.537*** | 0.152*** | 0.607 |
| *Insur* | 7.563*** | -0.600*** | -0.025*** | -0.301*** | 0.063*** | 0.571 |
| *RlEst* | 15.042*** | -0.707*** | -0.480*** | -0.363*** | 0.106*** | 0.465 |
| *Fin* | 7.744*** | -0.780*** | -0.145*** | -0.223*** | 0.173*** | 0.613 |
| *Other* | 9.066*** | -0.619*** | -0.088*** | -0.019 | 0.110*** | 0.387 |

The regression results show statistically significant results in 38 of 49 Industry indices, with no indices reporting negative alphas. Of the 38 indices, the abnormal returns for the MA in excess of the BH range from 2.493% to 15.042% per annum.

In terms of the best performing industries for the MA the top ten performers are as follows:

| | | | |
|---|---|---|---|
| *RlEst* 15.042% | *Hlth* 12.236% | *Txtls* 11.556% | *Steel* 11.15% |
| *Mines* 9.825% | *FabPr* 9.782% | *PerSv* 9.611% | *Other* 9.066% |
| *BldMt* 8.906% | *Clths* 8.800% | | |

These are considerable abnormal returns, with a spread of only 6.242% separating the top ten. Consider this is the mean abnormal return per annum for the time period July 1, 1969 to October 31, 2018. This is a substantial investment time period to be accruing such high returns in excess of the BH. In regards to the top performer *RlEst*, the results support the findings of Glabadanidis (2014) who found alphas of up to 15% per annum.

The overall results clearly highlight the ability of the MA to outperform the BH. The issue with the current results is the lack of consistent positive abnormal returns across all indices, with 11 indices not achieving statistically significant results. Consequently, further analysis is needed and takes place in subsequent sections.

### 3.3.3 Market Timing

The following section contains regression analysis using model (4) and (5) from Section 1.6 to determine if market timing played a role in the MA outperforming the BH from Section 3.3.2.

The results can be seen in Table 65 and shows some evidence of market timing for the MA, although not all indices which had statistically significant alphas report results in favour of market timing.

For the top ten indices detailed in Section 3.3.2, all except *Mines* indicate some level of market timing. For the market timing method of Treynor and Mazuy (1966), *Hlth*, *Txtls*, *Steel*, *FabPr*, *Persv*, *Other*, *BldMt* and *Clths* all report evidence in favour of market timing. For the Henriksson and Merton (1981) method, *RlEst, Hlth*, *Txtls*, *FabPr*, *Other*, *BldMt* and *Clths* all report evidence in favour of market timing.

**Table 64: Market Timing Results for Value Weighted US Portfolios by Industry**

| | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| *Agric* | 3.257* | -0.435*** | -0.005*** | 0.250 | -2.031 | -0.409*** | 0.046** | 0.250 |
| *Food* | -1.057 | -0.360*** | 0.009*** | 0.418 | -0.428 | -0.354*** | 0.019* | 0.414 |
| *Soda* | -1.897 | -0.440*** | 0.009*** | 0.260 | -0.736 | -0.437*** | 0.014 | 0.259 |
| *Beer* | -1.419 | -0.373*** | 0.006*** | 0.292 | -0.319 | -0.373*** | 0.005 | 0.291 |
| *Smoke* | -1.703 | -0.364*** | 0.002 | 0.192 | -0.855 | -0.366*** | -0.003 | 0.192 |
| *Toys* | 4.417** | -0.613*** | 0.011*** | 0.408 | 2.600 | -0.589*** | 0.055*** | 0.406 |
| *Fun* | 2.389 | -0.737*** | 0.018*** | 0.454 | -1.280 | -0.696*** | 0.095*** | 0.451 |
| *Books* | 5.352*** | -0.569*** | 0.010*** | 0.510 | 3.550* | -0.547*** | 0.051*** | 0.508 |
| *Hshld* | -1.273 | -0.462*** | 0.012*** | 0.429 | -0.017 | -0.456*** | 0.021 | 0.425 |
| *Clths* | 6.282*** | -0.551*** | 0.008*** | 0.466 | 5.747*** | -0.539*** | 0.031** | 0.465 |
| *Hlth* | 10.263*** | -0.552*** | 0.009*** | 0.301 | 6.915** | -0.522*** | 0.065*** | 0.300 |
| *MedEq* | 1.479 | -0.507*** | 0.006*** | 0.450 | 2.762 | -0.509*** | 0.003 | 0.449 |
| *Drugs* | 0.120 | -0.487*** | 0.007*** | 0.459 | 1.750 | -0.489*** | 0.003 | 0.458 |
| *Chems* | 2.831** | -0.593*** | 0.009*** | 0.535 | 2.332 | -0.580*** | 0.032** | 0.533 |
| *Rubbr* | 3.684*** | -0.505*** | 0.011*** | 0.467 | 1.213 | -0.479*** | 0.061*** | 0.465 |
| *Txtls* | 6.815*** | -0.567*** | 0.014*** | 0.399 | 3.704 | -0.533*** | 0.078*** | 0.396 |
| *BldMt* | 5.195*** | -0.580*** | 0.010*** | 0.543 | 4.563** | -0.565*** | 0.038*** | 0.541 |
| *Cnstr* | 8.259*** | -0.733*** | 0.003* | 0.503 | 7.708*** | -0.726*** | 0.015 | 0.503 |
| *Steel* | 9.865*** | -0.798*** | 0.004** | 0.529 | 9.023*** | -0.789*** | 0.020 | 0.529 |
| *FabPr* | 8.259*** | -0.588*** | 0.004** | 0.370 | 5.578** | -0.568*** | 0.043** | 0.370 |
| *Mach* | 8.516*** | -0.673*** | 0.000 | 0.603 | 10.370*** | -0.684*** | -0.022 | 0.603 |
| *ElcEq* | 3.354** | -0.669*** | 0.004*** | 0.565 | 5.462*** | -0.676*** | -0.011 | 0.565 |
| *Autos* | 5.761*** | -0.688*** | 0.008*** | 0.520 | 4.874** | -0.673*** | 0.035** | 0.519 |
| *Aero* | 4.857*** | -0.595*** | 0.006*** | 0.475 | 3.599* | -0.581*** | 0.032** | 0.474 |
| *Ships* | 3.413* | -0.478*** | 0.006*** | 0.28 | -0.039 | -0.450*** | 0.059*** | 0.279 |
| *Guns* | -3.586** | -0.391*** | 0.017*** | 0.242 | -5.782** | -0.359*** | 0.078*** | 0.235 |
| *Gold* | 4.546 | *-0.275**** | *-0.014**** | *0.034* | 3.597 | *-0.285**** | *-0.031* | *0.033* |
| *Mines* | 8.378*** | -0.654*** | 0.001 | 0.377 | 7.996*** | -0.650*** | 0.008 | 0.377 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Coal* | 8.231** | -0.779*** | -0.003 | 0.247 | 6.845 | -0.774*** | 0.007 | 0.247 |
| *Oil* | 0.641 | -0.554*** | 0.005*** | 0.403 | 4.024* | -0.569*** | -0.025 | 0.402 |
| *Util* | 3.924*** | -0.336*** | 0.001 | 0.343 | 4.225*** | -0.338*** | -0.002 | 0.343 |
| *Telcm* | 3.553*** | -0.518*** | -0.003*** | 0.501 | 6.426*** | -0.539*** | -0.043*** | 0.501 |
| *PerSv* | 8.534*** | -0.566*** | 0.003** | 0.418 | 7.853*** | -0.558*** | 0.018 | 0.418 |
| *BusSv* | 6.699*** | -0.590*** | 0.008*** | 0.616 | 4.142*** | -0.566*** | 0.053*** | 0.614 |
| *Hardw* | 6.479*** | -0.767*** | -0.004** | 0.474 | 15.654*** | -0.827*** | -0.118*** | 0.475 |
| *Softw* | 11.784*** | -0.802*** | -0.010*** | 0.265 | 18.949*** | -0.856*** | -0.113*** | 0.264 |
| *Chips* | 10.830*** | -0.783*** | -0.009*** | 0.526 | 16.296*** | -0.826*** | -0.090*** | 0.526 |
| *LabEq* | 7.106*** | -0.687*** | 0.005*** | 0.541 | 7.909*** | -0.687*** | 0.006 | 0.540 |
| *Paper* | 2.786** | -0.508*** | 0.013*** | 0.519 | 2.755* | -0.493*** | 0.040*** | 0.514 |
| *Boxes* | 0.819 | -0.539*** | 0.010*** | 0.460 | -0.027 | -0.523*** | 0.040*** | 0.458 |
| *Trans* | 4.316*** | -0.581*** | 0.009*** | 0.537 | 3.960** | -0.569*** | 0.030** | 0.536 |
| *Whlsl* | 6.605*** | -0.512*** | 0.004*** | 0.546 | 5.081*** | -0.498*** | 0.029** | 0.546 |
| *Rtail* | 3.640*** | -0.546*** | 0.004*** | 0.520 | 6.921*** | -0.561*** | -0.024* | 0.520 |
| *Meals* | 4.642*** | -0.535*** | 0.004*** | 0.421 | 3.851* | -0.526*** | 0.022 | 0.421 |
| *Banks* | 7.075*** | -0.696*** | -0.003 | 0.503 | 12.469*** | -0.731*** | -0.070*** | 0.504 |
| *Insur* | 7.081*** | -0.574*** | -0.002 | 0.526 | 7.974*** | -0.581*** | -0.015 | 0.526 |
| *RlEst* | 13.417*** | -0.648*** | 0.001 | 0.376 | 10.457*** | -0.629*** | 0.037* | 0.376 |
| *Fin* | 10.092*** | -0.769*** | -0.008*** | 0.576 | 14.120*** | -0.802*** | -0.071*** | 0.576 |
| *Other* | 8.054*** | -0.619*** | 0.007*** | 0.380 | 6.792*** | -0.605*** | 0.034* | 0.379 |

While the results are not universal, it appears the MA does have market timing characteristics, supporting the results of Section 3.3.2 which found positive statistically significant alphas for 39 indices.

### 3.3.4 Trading Statistics

The trading statistics are discussed in this section with the data contained in Table 66. The reported statistics follow from the methodology used in Glabadanidis (2017).

Each table contains the following variables: $\Delta\mu$ is the MA change in mean return, $\Delta\sigma$ is the MA improved change in standard deviation, *pA* is the proportion of days not trading, *NT* is the number of trades, *BETC* is the break-even transaction costs, *p1* is the proportion of days a buy signal is followed by a positive return of the underlying, *p2* is the proportion of days a buy signal is followed by a positive return in excess of the risk-free rate, *NT/6* and *BETC*6* is the adjusted number of trades and break-even transaction costs given the results are based on a CMA of 6 equal weighted moving average strategies.

**Table 66: Summary Trading Statistics for Value Weighted US Portfolios by Industry**

| *Portfolio* | $\Delta\mu$ | $\Delta\sigma$ | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|
| *Agric* | -0.78 | 8.85 | 0.59 | 5274 | -0.01 | 0.66 | 0.52 | 879 | -0.04 |
| *Food* | -1.06 | 5.59 | 0.64 | 5242 | -0.01 | 0.67 | 0.53 | 874 | -0.06 |
| *Soda* | -2.37 | 8.52 | 0.60 | 5326 | -0.02 | 0.67 | 0.52 | 888 | -0.13 |
| *Beer* | -2.29 | 6.76 | 0.63 | 5420 | -0.02 | 0.66 | 0.52 | 903 | -0.13 |
| *Smoke* | -3.44 | 8.19 | 0.63 | 5387 | -0.03 | 0.66 | 0.52 | 898 | -0.19 |
| *Toys* | 3.49 | 9.86 | 0.56 | 5301 | 0.03 | 0.68 | 0.51 | 884 | 0.20 |
| *Fun* | 2.28 | 11.52 | 0.60 | 5296 | 0.02 | 0.66 | 0.52 | 883 | 0.13 |
| *Books* | 4.35 | 8.34 | 0.59 | 5030 | 0.04 | 0.68 | 0.52 | 838 | 0.26 |
| *Hshld* | -1.13 | 7.19 | 0.62 | 5372 | -0.01 | 0.66 | 0.52 | 895 | -0.06 |
| *Clths* | 4.95 | 8.31 | 0.60 | 4959 | 0.05 | 0.69 | 0.52 | 826 | 0.30 |
| *Hlth* | 9.05 | 10.60 | 0.59 | 4998 | 0.09 | 0.69 | 0.53 | 833 | 0.54 |
| *MedEq* | -0.23 | 7.66 | 0.62 | 5264 | 0.00 | 0.67 | 0.53 | 877 | -0.01 |
| *Drugs* | -1.15 | 7.33 | 0.62 | 5196 | -0.01 | 0.67 | 0.53 | 866 | -0.07 |
| *Chems* | 1.36 | 8.35 | 0.61 | 5124 | 0.01 | 0.67 | 0.52 | 854 | 0.08 |
| *Rubbr* | 3.27 | 7.66 | 0.61 | 5130 | 0.03 | 0.68 | 0.53 | 855 | 0.19 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Txtls* | 6.85 | 9.53 | 0.58 | 4917 | 0.07 | 0.70 | 0.52 | 820 | 0.42 |
| *BldMt* | 4.12 | 8.28 | 0.61 | 5022 | 0.04 | 0.67 | 0.53 | 837 | 0.25 |
| *Cnstr* | 4.33 | 10.84 | 0.56 | 5211 | 0.04 | 0.68 | 0.51 | 868 | 0.25 |
| *Steel* | 5.70 | 11.65 | 0.56 | 5069 | 0.06 | 0.67 | 0.51 | 845 | 0.34 |
| *FabPr* | 5.54 | 10.08 | 0.57 | 5142 | 0.05 | 0.67 | 0.51 | 857 | 0.32 |
| *Mach* | 4.21 | 9.13 | 0.60 | 4966 | 0.04 | 0.68 | 0.53 | 828 | 0.25 |
| *ElcEq* | 0.24 | 9.21 | 0.61 | 5361 | 0.00 | 0.65 | 0.51 | 894 | 0.01 |
| *Autos* | 3.56 | 9.97 | 0.57 | 5320 | 0.03 | 0.67 | 0.51 | 887 | 0.20 |
| *Aero* | 2.55 | 8.72 | 0.61 | 5114 | 0.02 | 0.67 | 0.53 | 852 | 0.15 |
| *Ships* | 2.05 | 8.96 | 0.59 | 5319 | 0.02 | 0.67 | 0.52 | 886 | 0.12 |
| *Guns* | -1.57 | 8.10 | 0.62 | 5335 | -0.01 | 0.67 | 0.52 | 889 | -0.09 |
| *Gold* | *-0.82* | *15.08* | *0.50* | *5576* | *-0.01* | *0.67* | *0.48* | *929* | *-0.04* |
| *Mines* | 4.54 | 11.08 | 0.56 | 5141 | 0.04 | 0.67 | 0.51 | 857 | 0.26 |
| *Coal* | 2.52 | 16.06 | 0.53 | 5391 | 0.02 | 0.66 | 0.50 | 898 | 0.14 |
| *Oil* | -1.70 | 8.88 | 0.61 | 5325 | -0.02 | 0.66 | 0.52 | 888 | -0.10 |
| *Util* | 1.95 | 5.76 | 0.63 | 4930 | 0.02 | 0.67 | 0.53 | 822 | 0.12 |
| *Telcm* | -0.61 | 7.51 | 0.61 | 5334 | -0.01 | 0.67 | 0.52 | 889 | -0.03 |
| *PerSv* | 5.78 | 9.11 | 0.58 | 5103 | 0.06 | 0.67 | 0.51 | 850 | 0.34 |
| *BusSv* | 5.02 | 7.99 | 0.62 | 4865 | 0.05 | 0.69 | 0.53 | 811 | 0.31 |
| *Hardw* | 0.50 | 11.70 | 0.56 | 5394 | 0.00 | 0.68 | 0.51 | 899 | 0.03 |
| *Softw* | 4.00 | 16.58 | 0.58 | 5226 | 0.04 | 0.69 | 0.51 | 871 | 0.23 |
| *Chips* | 3.49 | 11.31 | 0.59 | 5126 | 0.03 | 0.69 | 0.52 | 854 | 0.20 |
| *LabEq* | 4.05 | 9.70 | 0.60 | 5167 | 0.04 | 0.68 | 0.53 | 861 | 0.23 |
| *Paper* | 2.98 | 7.22 | 0.60 | 5070 | 0.03 | 0.68 | 0.53 | 845 | 0.18 |
| *Boxes* | -0.01 | 8.08 | 0.60 | 5346 | 0.00 | 0.67 | 0.52 | 891 | 0.00 |
| *Trans* | 2.88 | 8.14 | 0.61 | 5133 | 0.03 | 0.67 | 0.52 | 856 | 0.17 |
| *Whlsl* | 4.35 | 7.11 | 0.61 | 4925 | 0.04 | 0.69 | 0.53 | 821 | 0.26 |
| *Rtail* | 1.33 | 7.73 | 0.61 | 5093 | 0.01 | 0.68 | 0.53 | 849 | 0.08 |
| *Meals* | 2.35 | 8.46 | 0.62 | 5166 | 0.02 | 0.68 | 0.53 | 861 | 0.14 |
| *Banks* | 1.98 | 10.53 | 0.61 | 5098 | 0.02 | 0.67 | 0.52 | 850 | 0.12 |
| *Insur* | 2.99 | 8.28 | 0.63 | 4990 | 0.03 | 0.68 | 0.53 | 832 | 0.18 |
| *RlEst* | 9.54 | 11.47 | 0.55 | 5072 | 0.09 | 0.69 | 0.51 | 845 | 0.56 |
| *Fin* | 3.07 | 10.79 | 0.61 | 4851 | 0.03 | 0.67 | 0.53 | 808 | 0.19 |
| *Other* | 5.81 | 10.97 | 0.56 | 5095 | 0.06 | 0.70 | 0.52 | 849 | 0.34 |

When reviewing the 49 indices overall, the summary trading statistics show the MA only requires an investor to trade a minimum 50% of the time. Of those trading days, each time a buy signal was triggered, the MA accrued a positive return a minimum 66% of the time, with a minimum 48% of those buy trades accruing a return in excess of the risk-free rate. The minimum values quoted for *pA* and *p2* are from the *Gold* index which did not report a

statistically significant return. Using only statistically significant results alters the *pA* and *p2* values to 53% and 50% respectively.

In either case, it is clear the MA has a strong ability to correctly identify future market movements. Even at 48% chance for returns above the risk-free rate following a buy signal, should the MA be coupled with fundamental analysis for decision making, the profitability is likely to rise significantly as found by Neely et al. (2014).

The adjusted *BETC*6* values for all 49 indices range from -19 to 56 basis points. The adjusted *BETC*6* for the top ten indices sorted by statistically significant alpha as stated in Section 3.3.2 reported as basis points are:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *RlEst* | 56 | *Hlth* | 54 | *Txtls* | 42 | *Steel* | 34 | *Mines* | 26 |
| *FabPr* | 32 | *PerSv* | 34 | *Other* | 34 | *BldMt* | 25 | *Clths* | 30 |

While each individual investor, especially retail, will incur different transaction costs, the academic rule of thumb is to apply a transaction cost between 1 and 50 basis points per trade (Balduzzi & Lynch 1999). As a result, only 2 of 49 indices achieve a *BETC* in excess of the maximum transaction cost generally applied. However, the top ten still have considerably high *BETC* with a minimum of 25 basis points. Based on these findings it would appear it is possible to achieve a MA excess returns above the BH after cost, although the key is to keep transaction costs as low as possible. This is far easier for wholesale investors trading in much larger value and volume.

## 3.4 Equal Weighted Results

The regression results analysed in this section correspond to the equal weighted indices. The weight of each asset is calculated by equally distributing the investment across all assets, irrespective of fundamentals.

### 3.4.1 Summary Statistics

The summary statistics for the equal weighted indices can be found in Table 67. As already seen in Section 3.3.1, the table contains five statistics each for the BH, MA and TIS portfolios.

The results show a considerable amount of risk reduction for the MA over the BH, with the standard deviation of returns decreasing and the *SR* increasing for all indices. In some instances, the *SR* is three times or more higher for the MA relative to the BH.

The inconsistency for the MA continues with its returns, as not all indices generate a MA return in excess of the BH. The results do show three standout indices for the TIS portfolio, *Hardw*, *Softw* and *Chips* each with double digit positive excess returns.

In general, table 67 shows varied performance results when using the MA across the Industry indices.

**Table 67: Summary Statistics for Equal Weighted US Portfolios by Industry**

Equal Weighted Portfolios sorted on Size and B/M where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | BH | | | | | MA | | | | | TIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| *Agric* | 16.57 | 22.52 | 0.51 | 9.62 | 0.53 | 15.02 | 14.25 | 0.75 | 13.27 | 0.73 | -1.54 | 13.87 | -1.09 | 30.87 | -0.11 |
| *Food* | 18.15 | 12.57 | -0.33 | 15.33 | 1.08 | 19.23 | 8.01 | 0.02 | 7.83 | 1.83 | 1.08 | 7.78 | 1.19 | 65.97 | 0.14 |
| *Soda* | 19.93 | 21.33 | 0.31 | 9.24 | 0.72 | 16.22 | 14.53 | 0.63 | 15.95 | 0.80 | -3.71 | 11.99 | -0.28 | 31.51 | -0.31 |
| *Beer* | 18.56 | 16.93 | 0.55 | 11.49 | 0.83 | 15.07 | 11.48 | 1.23 | 24.06 | 0.92 | -3.48 | 9.83 | -0.55 | 33.21 | -0.35 |
| *Smoke* | 22.66 | 24.16 | 1.60 | 34.13 | 0.75 | 17.88 | 16.60 | 3.45 | 95.12 | 0.80 | -4.78 | 13.35 | -1.04 | 39.54 | -0.36 |
| *Toys* | 18.20 | 19.06 | 0.14 | 11.22 | 0.72 | 23.88 | 11.82 | 0.78 | 10.93 | 1.63 | 5.67 | 12.20 | 0.33 | 44.12 | 0.46 |
| *Fun* | 21.00 | 18.60 | -0.02 | 12.04 | 0.88 | 26.90 | 11.37 | 1.03 | 17.75 | 1.96 | 5.90 | 12.07 | 0.65 | 37.87 | 0.49 |
| *Books* | 16.98 | 18.14 | 0.23 | 16.96 | 0.68 | 22.11 | 10.81 | 1.05 | 21.36 | 1.62 | 5.13 | 11.80 | 0.25 | 39.06 | 0.43 |
| *Hshld* | 16.65 | 15.73 | -0.12 | 14.85 | 0.77 | 23.36 | 9.41 | 0.55 | 12.12 | 2.00 | 6.71 | 10.33 | 1.22 | 40.58 | 0.65 |
| *Clths* | 18.77 | 17.46 | 0.24 | 16.56 | 0.81 | 24.83 | 10.84 | 1.67 | 35.69 | 1.87 | 6.06 | 11.04 | 0.95 | 35.64 | 0.55 |
| *Hlth* | 22.69 | 20.09 | 0.01 | 16.49 | 0.90 | 31.19 | 11.84 | 0.84 | 11.39 | 2.25 | 8.51 | 13.40 | 0.79 | 51.55 | 0.63 |
| *MedEq* | 21.32 | 16.85 | -0.47 | 9.69 | 0.99 | 29.42 | 10.14 | 0.23 | 7.48 | 2.45 | 8.10 | 11.00 | 1.21 | 35.68 | 0.74 |
| *Drugs* | 23.07 | 19.83 | -0.38 | 11.15 | 0.93 | 31.01 | 11.96 | 0.34 | 10.89 | 2.21 | 7.94 | 12.87 | 0.98 | 37.55 | 0.62 |
| *Chems* | 18.17 | 17.38 | -0.36 | 15.16 | 0.78 | 22.11 | 10.23 | 0.26 | 11.32 | 1.71 | 3.93 | 11.49 | 1.24 | 45.42 | 0.34 |
| *Rubbr* | 21.22 | 18.01 | 2.06 | 71.38 | 0.92 | 24.29 | 11.52 | 4.91 | 180.75 | 1.71 | 3.07 | 11.05 | 0.17 | 46.86 | 0.28 |
| *Txtls* | 14.24 | 19.05 | 0.02 | 12.38 | 0.51 | 21.76 | 11.71 | 0.57 | 18.90 | 1.47 | 7.52 | 12.22 | 0.59 | 34.19 | 0.61 |
| *BldMt* | 19.21 | 16.31 | -0.26 | 11.91 | 0.90 | 25.73 | 9.83 | 0.27 | 10.29 | 2.15 | 6.52 | 10.52 | 0.96 | 35.46 | 0.62 |
| *Cnstr* | 18.25 | 22.38 | 2.06 | 69.50 | 0.61 | 24.58 | 13.69 | 5.45 | 212.43 | 1.46 | 6.33 | 14.19 | 0.19 | 33.18 | 0.45 |
| *Steel* | 15.18 | 21.29 | -0.20 | 15.99 | 0.50 | 22.63 | 12.05 | 0.12 | 13.20 | 1.50 | 7.45 | 14.33 | 0.44 | 43.46 | 0.52 |
| *FabPr* | 16.75 | 22.53 | 0.10 | 12.13 | 0.54 | 19.37 | 13.40 | 0.39 | 11.22 | 1.10 | 2.62 | 14.68 | 0.02 | 36.58 | 0.18 |
| *Mach* | 19.00 | 17.73 | -0.38 | 14.18 | 0.81 | 25.27 | 10.21 | -0.18 | 9.52 | 2.03 | 6.28 | 11.82 | 0.78 | 39.77 | 0.53 |
| *ElcEq* | 21.18 | 18.00 | -0.18 | 9.34 | 0.92 | 28.66 | 11.10 | 0.52 | 8.42 | 2.17 | 7.49 | 11.59 | 0.86 | 33.55 | 0.65 |
| *Autos* | 15.72 | 19.81 | -0.13 | 14.54 | 0.56 | 23.48 | 11.26 | 0.57 | 17.47 | 1.68 | 7.75 | 13.43 | 0.81 | 35.90 | 0.58 |
| *Aero* | 21.64 | 20.02 | 0.08 | 9.73 | 0.85 | 22.56 | 12.88 | 0.68 | 14.69 | 1.40 | 0.91 | 12.18 | 0.17 | 30.83 | 0.07 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ships* | 16.55 | 25.56 | 0.13 | 7.80 | 0.47 | 15.68 | 15.56 | 0.26 | 9.04 | 0.71 | -0.87 | 16.26 | -0.04 | 24.17 | -0.05 |
| *Guns* | 22.67 | 23.48 | 0.94 | 18.06 | 0.77 | 21.15 | 15.90 | 2.15 | 36.02 | 1.04 | -1.52 | 13.55 | 0.56 | 31.23 | -0.11 |
| *Gold* | 24.98 | 37.83 | 0.46 | 8.82 | 0.54 | 24.69 | 24.53 | 1.21 | 16.28 | 0.82 | -0.29 | 22.74 | -0.18 | 25.49 | -0.01 |
| *Mines* | 20.47 | 25.89 | 0.23 | 8.83 | 0.61 | 21.97 | 16.39 | 0.78 | 12.51 | 1.06 | 1.49 | 15.78 | 0.19 | 24.06 | 0.09 |
| *Coal* | 14.62 | 38.57 | 0.56 | 18.72 | 0.26 | 14.61 | 22.01 | 0.59 | 14.72 | 0.46 | -0.01 | 26.30 | -1.38 | 63.15 | 0.00 |
| *Oil* | 19.84 | 24.05 | -0.15 | 14.99 | 0.64 | 29.06 | 13.72 | 0.31 | 11.90 | 1.79 | 9.22 | 16.25 | 0.25 | 44.68 | 0.57 |
| *Util* | 13.63 | 11.81 | -0.04 | 25.98 | 0.77 | 14.43 | 7.07 | -0.40 | 10.49 | 1.40 | 0.80 | 7.76 | -1.29 | 107.70 | 0.10 |
| *Telcm* | 18.80 | 19.11 | -0.09 | 11.21 | 0.74 | 27.58 | 10.85 | 0.50 | 9.59 | 2.12 | 8.77 | 13.04 | 0.41 | 30.45 | 0.67 |
| *PerSv* | 18.21 | 18.41 | -0.10 | 9.59 | 0.74 | 23.34 | 11.25 | 0.61 | 11.43 | 1.67 | 5.13 | 11.91 | 0.98 | 29.52 | 0.43 |
| *BusSv* | 21.77 | 15.85 | -0.49 | 11.78 | 1.08 | 29.16 | 9.34 | 0.02 | 7.59 | 2.63 | 7.39 | 10.48 | 0.95 | 37.11 | 0.71 |
| *Hardw* | 19.02 | 21.48 | -0.17 | 9.19 | 0.67 | 30.70 | 12.32 | 0.31 | 7.29 | 2.12 | 11.68 | 14.45 | 0.53 | 26.78 | 0.81 |
| *Softw* | 18.60 | 29.78 | 0.35 | 21.23 | 0.47 | 29.54 | 15.36 | 0.91 | 24.74 | 1.63 | 10.94 | 21.51 | -0.17 | 46.79 | 0.51 |
| *Chips* | 23.02 | 20.65 | -0.13 | 10.19 | 0.89 | 33.89 | 11.90 | 0.26 | 8.12 | 2.46 | 10.87 | 13.89 | 0.25 | 29.53 | 0.78 |
| *LabEq* | 25.71 | 17.65 | -0.26 | 8.79 | 1.20 | 34.14 | 10.95 | 0.29 | 6.96 | 2.70 | 8.43 | 11.15 | 0.78 | 30.35 | 0.76 |
| *Paper* | 15.68 | 17.23 | 0.12 | 20.39 | 0.64 | 19.46 | 10.04 | 0.88 | 25.70 | 1.48 | 3.79 | 11.49 | 0.27 | 49.77 | 0.33 |
| *Boxes* | 17.27 | 19.75 | 0.10 | 11.58 | 0.64 | 17.26 | 12.25 | 0.66 | 23.05 | 1.04 | -0.02 | 12.43 | 0.12 | 29.41 | 0.00 |
| *Trans* | 17.07 | 17.58 | -0.31 | 11.08 | 0.71 | 22.25 | 10.28 | 0.19 | 8.40 | 1.72 | 5.18 | 11.67 | 0.71 | 32.59 | 0.44 |
| *Whlsl* | 18.40 | 15.20 | -0.44 | 12.29 | 0.91 | 26.43 | 8.88 | 0.12 | 8.12 | 2.46 | 8.03 | 10.16 | 1.12 | 38.96 | 0.79 |
| *Rtail* | 17.21 | 16.55 | -0.35 | 13.00 | 0.76 | 24.94 | 9.49 | 0.28 | 11.83 | 2.15 | 7.73 | 11.22 | 0.92 | 37.53 | 0.69 |
| *Meals* | 18.39 | 16.47 | -0.18 | 10.20 | 0.84 | 25.64 | 9.87 | 0.61 | 10.10 | 2.13 | 7.25 | 10.80 | 0.95 | 30.89 | 0.67 |
| *Banks* | 19.17 | 12.27 | -0.01 | 16.68 | 1.19 | 24.09 | 7.38 | 0.43 | 14.64 | 2.65 | 4.92 | 8.09 | 0.36 | 53.27 | 0.61 |
| *Insur* | 18.89 | 15.71 | 2.16 | 89.43 | 0.91 | 21.61 | 9.87 | 9.08 | 455.68 | 1.73 | 2.72 | 10.10 | -0.19 | 78.34 | 0.27 |
| *RlEst* | 18.38 | 20.76 | 0.72 | 19.53 | 0.67 | 22.53 | 12.88 | 1.13 | 19.27 | 1.40 | 4.16 | 13.27 | -0.13 | 38.96 | 0.31 |
| *Fin* | 19.23 | 15.19 | -0.04 | 15.97 | 0.96 | 23.70 | 8.67 | 0.02 | 14.89 | 2.21 | 4.48 | 10.33 | -0.32 | 42.50 | 0.43 |
| *Other* | 18.13 | 18.33 | 0.08 | 13.95 | 0.74 | 24.31 | 10.83 | 1.25 | 17.93 | 1.82 | 6.18 | 12.20 | 0.52 | 43.46 | 0.51 |

### 3.4.2 Factor Regression Analysis

Replicating the same methodology from Section 3.3.2, model (1), (2) and (3) from Section 1.6 are completed with model (3) reported and analysed as the other results do not add to the analysis.

The regression results can be found in Table 68, regressing the TIS excess returns using the Carhart 4-factor model. Statistical significance tests at the 90%, 95% and 99% confidence level are used, corresponding to *, ** and *** respectively.

**Table 68: Factor Regression Results for Equal Weighted US Portfolios by Industry**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where $f$ is the fixed percentage difference, $d$ is the fixed number of days crossed and $h$ is the minimum number of days held.

| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|
| *Agric* | 1.456 | -0.399*** | -0.333*** | -0.110*** | 0.029*** | 0.229 |
| *Food* | 3.840*** | -0.337*** | -0.192*** | -0.113*** | -0.003 | 0.473 |
| *Soda* | -0.839 | -0.355*** | -0.124*** | -0.072*** | -0.031*** | 0.215 |
| *Beer* | -1.356 | -0.304*** | -0.124*** | -0.003 | -0.012* | 0.245 |
| *Smoke* | -2.480 | -0.325*** | -0.071*** | -0.019 | -0.015 | 0.149 |
| *Toys* | 8.627*** | -0.451*** | -0.353*** | -0.053*** | 0.050*** | 0.383 |
| *Fun* | 9.154*** | -0.496*** | -0.392*** | -0.099*** | 0.078*** | 0.477 |
| *Books* | 9.126*** | -0.509*** | -0.383*** | -0.264*** | 0.076*** | 0.514 |
| *Hshld* | 10.104*** | -0.469*** | -0.327*** | -0.134*** | 0.048*** | 0.553 |
| *Clths* | 9.583*** | -0.463*** | -0.380*** | -0.160*** | 0.044*** | 0.486 |
| *Hlth* | 11.273*** | -0.457*** | -0.379*** | 0.031** | 0.037*** | 0.340 |
| *MedEq* | 10.890*** | -0.455*** | -0.380*** | 0.051*** | 0.022*** | 0.503 |
| *Drugs* | 11.117*** | -0.546*** | -0.428*** | 0.128*** | 0.012 | 0.539 |
| *Chems* | 8.002*** | -0.534*** | -0.317*** | -0.191*** | 0.042*** | 0.560 |
| *Rubbr* | 6.460*** | -0.445*** | -0.375*** | -0.178*** | 0.056*** | 0.455 |
| *Txtls* | 11.258*** | -0.472*** | -0.380*** | -0.210*** | 0.050*** | 0.411 |
| *BldMt* | 10.177*** | -0.485*** | -0.384*** | -0.181*** | 0.058*** | 0.585 |
| *Cnstr* | 11.472*** | -0.624*** | -0.481*** | -0.299*** | 0.050*** | 0.524 |
| *Steel* | 12.375*** | -0.657*** | -0.445*** | -0.293*** | 0.101*** | 0.570 |
| *FabPr* | 6.918*** | -0.536*** | -0.453*** | -0.266*** | 0.067*** | 0.374 |
| *Mach* | 10.034*** | -0.564*** | -0.403*** | -0.142*** | 0.091*** | 0.627 |
| *ElcEq* | 10.869*** | -0.513*** | -0.421*** | -0.093*** | 0.074*** | 0.557 |
| *Autos* | 12.304*** | -0.623*** | -0.408*** | -0.264*** | 0.102*** | 0.582 |
| *Aero* | 4.457*** | -0.499*** | -0.267*** | -0.116*** | 0.039*** | 0.434 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Ships* | 3.758** | -0.566*** | -0.411*** | -0.268*** | 0.046*** | 0.324 |
| *Guns* | 2.342 | -0.429*** | -0.247*** | -0.142*** | -0.052*** | 0.248 |
| *Gold* | *2.334* | *-0.323**** | *-0.375**** | *-0.077**** | *0* | *0.062* |
| *Mines* | 5.731*** | -0.535*** | -0.396*** | -0.203*** | 0.035*** | 0.307 |
| *Coal* | 5.526* | -0.765*** | -0.521*** | -0.374*** | 0.160*** | 0.235 |
| *Oil* | 13.154*** | -0.609*** | -0.398*** | -0.222*** | 0.149*** | 0.394 |
| *Util* | 3.648*** | -0.320*** | -0.064*** | -0.176*** | -0.008 | 0.415 |
| *Telcm* | 11.643*** | -0.569*** | -0.408*** | 0.030*** | 0.123*** | 0.559 |
| *PerSv* | 8.587*** | -0.479*** | -0.419*** | -0.099*** | 0.038*** | 0.457 |
| *BusSv* | 10.319*** | -0.469*** | -0.397*** | -0.003 | 0.047*** | 0.582 |
| *Hardw* | 14.131*** | -0.626*** | -0.461*** | 0.224*** | 0.127*** | 0.597 |
| *Softw* | 13.331*** | -0.597*** | -0.540*** | 0.243*** | 0.107*** | 0.260 |
| *Chips* | 13.279*** | -0.602*** | -0.494*** | 0.194*** | 0.132*** | 0.608 |
| *LabEq* | 11.022*** | -0.487*** | -0.395*** | 0.050*** | 0.078*** | 0.571 |
| *Paper* | 7.969*** | -0.523*** | -0.319*** | -0.275*** | 0.064*** | 0.550 |
| *Boxes* | 3.992*** | -0.510*** | -0.316*** | -0.171*** | 0.019** | 0.433 |
| *Trans* | 9.055*** | -0.534*** | -0.382*** | -0.190*** | 0.074*** | 0.570 |
| *Whlsl* | 11.292*** | -0.459*** | -0.381*** | -0.094*** | 0.040*** | 0.569 |
| *Rtail* | 11.510*** | -0.521*** | -0.396*** | -0.146*** | 0.054*** | 0.589 |
| *Meals* | 10.239*** | -0.450*** | -0.330*** | -0.091*** | 0.063*** | 0.480 |
| *Banks* | 7.921*** | -0.357*** | -0.238*** | -0.234*** | 0.051*** | 0.532 |
| *Insur* | 6.283*** | -0.452*** | -0.237*** | -0.239*** | 0.058*** | 0.524 |
| *RlEst* | 7.819*** | -0.501*** | -0.424*** | -0.257*** | 0.114*** | 0.417 |
| *Fin* | 7.803*** | -0.473*** | -0.331*** | -0.203*** | 0.098*** | 0.584 |
| *Other* | 8.979*** | -0.412*** | -0.339*** | -0.007 | 0.012 | 0.324 |

The results in Table 68 show 43 of 49 indices recording positive statistically significant abnormal returns for the MA over the BH. The other 6 report statistically insignificant results, with no indices reporting negative excess returns. Overall, for the 43 indices reporting statistically significant results, the alpha ranges from 3.648% to 14.131% per annum.

The top ten performers for the equal weighted indices are as follows:

| | | | |
|---|---|---|---|
| *Hardw 14.131%* | *Softw 13.331%* | *Chips 13.279%* | *Oil 13.154%* |
| *Steel 12.375%* | *Autos 12.304%* | *Telcm 11.643* | *Rtail 11.510%* |
| *Cnstr 11.472%* | *Whlsl 11.292%* | | |

The abnormal returns stated above are considerable given they are average per annum results. Additionally, the return spread across the top ten is very small at 2.839% per annum. As stated in Section 3.3.2, consider the implications of these results given we are looking at a time horizon from 1969 to 2018.

From the aforementioned analysis, the MA clearly has a strong ability to outperform the BH, with the most consistent performance metric its ability to increase the risk-return ratio for investors.

### 3.4.3 Market Timing

Model (4) and (5) from Section 1.6 are utilised in this section to determine the extent market timing played a role in the MA performance relative to the BH. The results can be found in Table 69.

The results found are not consistent across indices with evidence for and against market timing. In relation to the top ten discussed in the previous section, all excluding *Softw*, *Chips* and *Oil* found evidence in favour of market timing.

Of those results, *Autos*, *Rtail*, *Cnstr* and *Whlsl* all reported evidence of market timing through the Treynor and Mazuy (1966) method. Whereas, *Hardw*, *Steel*, *Autos*, *Telcm*, *Rtail*, *Cnstr* and *Whlsl* all reported evidence of market timing from the Henriksson and Merton (1981) method.

While the results discussed above show inconsistency across indices it does appear the MA has some market timing ability.

**Table 69: Market Timing Results for Equal Weighted US Portfolios by Industry**

| | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| *Agric* | -0.472 | -0.366*** | 0.005*** | 0.185 | -7.665*** | -0.318*** | 0.097*** | 0.186 |
| *Food* | 0.854 | -0.308*** | 0.008*** | 0.426 | -2.147* | -0.281*** | 0.060*** | 0.423 |
| *Soda* | -3.414** | -0.333*** | 0.007*** | 0.207 | -8.355*** | -0.296*** | 0.078*** | 0.207 |
| *Beer* | -2.075* | -0.293*** | 0.002 | 0.234 | -3.307** | -0.284*** | 0.019 | 0.234 |
| *Smoke* | -3.670** | -0.315*** | 0.003** | 0.147 | -4.357* | -0.307*** | 0.018 | 0.147 |
| *Toys* | 6.904*** | -0.425*** | 0.006*** | 0.321 | 3.234 | -0.397*** | 0.059*** | 0.321 |
| *Fun* | 6.267*** | -0.464*** | 0.010*** | 0.396 | 0.704 | -0.419*** | 0.094*** | 0.395 |
| *Books* | 6.340*** | -0.461*** | 0.007*** | 0.405 | 1.996 | -0.428*** | 0.070*** | 0.405 |
| *Hshld* | 6.931*** | -0.434*** | 0.010*** | 0.474 | 1.924 | -0.393*** | 0.087*** | 0.472 |
| *Clths* | 6.609*** | -0.423*** | 0.008*** | 0.391 | 3.282* | -0.394*** | 0.063*** | 0.390 |
| *Hlth* | 8.372*** | -0.434*** | 0.011*** | 0.284 | 2.730 | -0.388*** | 0.098*** | 0.283 |
| *MedEq* | 9.067*** | -0.435*** | 0.007*** | 0.415 | 4.386** | -0.399*** | 0.075*** | 0.415 |
| *Drugs* | 9.040*** | -0.529*** | 0.009*** | 0.451 | 3.595* | -0.487*** | 0.089*** | 0.450 |
| *Chems* | 5.103*** | -0.494*** | 0.008*** | 0.490 | 0.870 | -0.460*** | 0.072*** | 0.490 |
| *Rubbr* | 5.468*** | -0.408*** | 0.001 | 0.355 | 2.321 | -0.388*** | 0.038*** | 0.356 |
| *Txtls* | 6.615*** | -0.424*** | 0.014*** | 0.330 | 0.729 | -0.374*** | 0.109*** | 0.327 |
| *BldMt* | 7.856*** | -0.444*** | 0.006*** | 0.472 | 3.751** | -0.413*** | 0.065*** | 0.472 |
| *Cnstr* | 8.754*** | -0.565*** | 0.004*** | 0.417 | 5.507** | -0.540*** | 0.051*** | 0.417 |
| *Steel* | 10.756*** | -0.607*** | 0.002 | 0.470 | 7.474*** | -0.585*** | 0.044*** | 0.470 |
| *FabPr* | 3.113* | -0.480*** | 0.010*** | 0.287 | -1.378 | -0.443*** | 0.081*** | 0.286 |
| *Mach* | 9.326*** | -0.531*** | 0.001 | 0.528 | 6.791*** | -0.515*** | 0.033** | 0.529 |
| *ElcEq* | 9.471*** | -0.482*** | 0.004*** | 0.456 | 4.348** | -0.447*** | 0.071*** | 0.456 |
| *Autos* | 9.724*** | -0.576*** | 0.006*** | 0.486 | 5.557*** | -0.544*** | 0.068*** | 0.486 |
| *Aero* | 4.537*** | -0.475*** | -0.002* | 0.394 | 2.876 | -0.467*** | 0.012 | 0.394 |
| *Ships* | 0.435 | -0.512*** | 0.007*** | 0.264 | -3.175 | -0.483*** | 0.064*** | 0.263 |
| *Guns* | -3.579** | -0.385*** | 0.017*** | 0.227 | -8.491*** | -0.336*** | 0.109*** | 0.222 |
| *Gold* | 3.336 | *-0.294**** | *-0.007*** | *0.043* | 1.344 | *-0.289**** | *0.002* | *0.043* |
| *Mines* | 4.441** | -0.491*** | 0.001 | 0.253 | -1.101 | -0.458*** | 0.066*** | 0.254 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Coal* | 5.069 | -0.709*** | -0.002 | 0.189 | -1.370 | -0.673*** | 0.067* | 0.189 |
| *Oil* | 13.865*** | -0.577*** | -0.004* | 0.327 | 10.709*** | -0.562*** | 0.025 | 0.327 |
| *Util* | 3.070*** | -0.297*** | -0.001* | 0.381 | 3.796*** | -0.303*** | -0.013 | 0.381 |
| *Telcm* | 13.009*** | -0.560*** | -0.003* | 0.479 | 9.502*** | -0.542*** | 0.033** | 0.479 |
| *PerSv* | 5.918*** | -0.442*** | 0.008*** | 0.367 | 1.213 | -0.405*** | 0.078*** | 0.366 |
| *BusSv* | 9.104*** | -0.446*** | 0.004*** | 0.478 | 5.478*** | -0.420*** | 0.055*** | 0.478 |
| *Hardw* | 15.266*** | -0.632*** | 0.002 | 0.501 | 12.334*** | -0.613*** | 0.039** | 0.501 |
| *Softw* | 15.346*** | -0.600*** | -0.002 | 0.203 | 12.142*** | -0.584*** | 0.030 | 0.203 |
| *Chips* | 14.493*** | -0.604*** | 0.001 | 0.495 | 13.186*** | -0.596*** | 0.018 | 0.495 |
| *LabEq* | 10.304*** | -0.473*** | 0.004*** | 0.474 | 6.757*** | -0.447*** | 0.054*** | 0.475 |
| *Paper* | 5.549*** | -0.478*** | 0.005*** | 0.457 | 2.288 | -0.453*** | 0.052*** | 0.456 |
| *Boxes* | 2.361* | -0.472*** | 0.002* | 0.378 | -0.010 | -0.455*** | 0.035** | 0.378 |
| *Trans* | 8.100*** | -0.497*** | 0.001 | 0.473 | 5.452*** | -0.480*** | 0.033** | 0.473 |
| *Whlsl* | 9.126*** | -0.425*** | 0.006*** | 0.465 | 5.427*** | -0.396*** | 0.061*** | 0.465 |
| *Rtail* | 9.069*** | -0.483*** | 0.007*** | 0.491 | 5.794*** | -0.456*** | 0.058*** | 0.490 |
| *Meals* | 7.970*** | -0.422*** | 0.008*** | 0.407 | 2.790 | -0.383*** | 0.082*** | 0.407 |
| *Banks* | 6.141*** | -0.320*** | 0.003*** | 0.413 | 5.282*** | -0.312*** | 0.019* | 0.413 |
| *Insur* | 6.019*** | -0.418*** | -0.002** | 0.445 | 5.781*** | -0.419*** | -0.005 | 0.444 |
| *RlEst* | 6.905*** | -0.457*** | 0.001 | 0.310 | 3.019 | -0.434*** | 0.047*** | 0.311 |
| *Fin* | 8.286*** | -0.442*** | -0.004*** | 0.474 | 9.596*** | -0.454*** | -0.027** | 0.474 |
| *Other* | 5.714*** | -0.386*** | 0.011*** | 0.272 | 1.788 | -0.350*** | 0.079*** | 0.270 |

### 3.4.4 Trading Statistics

The following section contains the trading statistics for the MA and can be seen in Table 70. The table contains the same nine statistics defined and reported in Section 3.3.4.

Across the 49 industries, the results show investors would be trading a minimum 47% of the time. For buy signal trades, a positive return is achieved a minimum 65% of the time with a minimum 49% of those positive returns in excess of the risk-free rate.

Similar to Section 3.3.4, two of the three minimum values stated above are achieved for *Gold* which does not return a statistically significant alpha. Using only statistically significant results, the *p1* and *p2* values increase to 66% and 50% respectively.

**Table 70: Summary Trading Statistics for Equal Weighted US Portfolios by Industry**

| *Portfolio* | $\Delta\mu$ | $\Delta\sigma$ | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|
| *Agric* | -1.54 | 8.27 | 0.59 | 5341 | -0.01 | 0.66 | 0.51 | 890 | -0.09 |
| *Food* | 1.08 | 4.56 | 0.70 | 4658 | 0.01 | 0.67 | 0.56 | 776 | 0.07 |
| *Soda* | -3.71 | 6.80 | 0.64 | 5206 | -0.04 | 0.65 | 0.52 | 868 | -0.21 |
| *Beer* | -3.48 | 5.46 | 0.65 | 5371 | -0.03 | 0.65 | 0.53 | 895 | -0.19 |
| *Smoke* | -4.78 | 7.56 | 0.64 | 5293 | -0.04 | 0.66 | 0.52 | 882 | -0.27 |
| *Toys* | 5.67 | 7.24 | 0.62 | 4758 | 0.06 | 0.68 | 0.53 | 793 | 0.36 |
| *Fun* | 5.90 | 7.23 | 0.64 | 4714 | 0.06 | 0.67 | 0.54 | 786 | 0.37 |
| *Books* | 5.13 | 7.33 | 0.64 | 4636 | 0.06 | 0.68 | 0.54 | 773 | 0.33 |
| *Hshld* | 6.71 | 6.31 | 0.63 | 4537 | 0.07 | 0.69 | 0.55 | 756 | 0.44 |
| *Clths* | 6.06 | 6.62 | 0.63 | 4524 | 0.07 | 0.68 | 0.54 | 754 | 0.40 |
| *Hlth* | 8.51 | 8.25 | 0.65 | 4432 | 0.10 | 0.69 | 0.54 | 739 | 0.57 |
| *MedEq* | 8.10 | 6.71 | 0.64 | 4325 | 0.09 | 0.69 | 0.56 | 721 | 0.56 |
| *Drugs* | 7.94 | 7.87 | 0.63 | 4521 | 0.09 | 0.70 | 0.56 | 754 | 0.52 |
| *Chems* | 3.93 | 7.15 | 0.66 | 4595 | 0.04 | 0.67 | 0.55 | 766 | 0.26 |
| *Rubbr* | 3.07 | 6.49 | 0.65 | 4718 | 0.03 | 0.67 | 0.54 | 786 | 0.19 |
| *Txtls* | 7.52 | 7.34 | 0.59 | 4682 | 0.08 | 0.69 | 0.53 | 780 | 0.48 |
| *BldMt* | 6.52 | 6.48 | 0.65 | 4340 | 0.07 | 0.68 | 0.55 | 723 | 0.45 |
| *Cnstr* | 6.33 | 8.68 | 0.60 | 4809 | 0.07 | 0.68 | 0.53 | 802 | 0.39 |
| *Steel* | 7.45 | 9.24 | 0.60 | 4677 | 0.08 | 0.68 | 0.53 | 780 | 0.48 |
| *FabPr* | 2.62 | 9.12 | 0.60 | 4912 | 0.03 | 0.66 | 0.52 | 819 | 0.16 |
| *Mach* | 6.28 | 7.52 | 0.65 | 4405 | 0.07 | 0.69 | 0.56 | 734 | 0.43 |
| *ElcEq* | 7.49 | 6.90 | 0.63 | 4499 | 0.08 | 0.68 | 0.54 | 750 | 0.50 |
| *Autos* | 7.75 | 8.55 | 0.61 | 4667 | 0.08 | 0.68 | 0.53 | 778 | 0.50 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Aero* | 0.91 | 7.13 | 0.64 | 4989 | 0.01 | 0.66 | 0.53 | 832 | 0.05 |
| *Ships* | -0.87 | 10.00 | 0.59 | 5291 | -0.01 | 0.67 | 0.51 | 882 | -0.05 |
| *Guns* | -1.52 | 7.58 | 0.61 | 5212 | -0.01 | 0.67 | 0.52 | 869 | -0.09 |
| *Gold* | -0.29 | 13.31 | 0.55 | 5311 | 0.00 | 0.65 | 0.49 | 885 | -0.02 |
| *Mines* | 1.49 | 9.50 | 0.59 | 5104 | 0.01 | 0.66 | 0.52 | 851 | 0.09 |
| *Coal* | -0.01 | 16.56 | 0.53 | 5405 | 0.00 | 0.66 | 0.50 | 901 | 0.00 |
| *Oil* | *9.22* | *10.33* | *0.62* | *4435* | *0.10* | *0.68* | *0.54* | *739* | *0.62* |
| *Util* | 0.80 | 4.73 | 0.68 | 4573 | 0.01 | 0.67 | 0.56 | 762 | 0.05 |
| *Telcm* | 8.77 | 8.26 | 0.63 | 4426 | 0.10 | 0.69 | 0.55 | 738 | 0.59 |
| *PerSv* | 5.13 | 7.16 | 0.62 | 4793 | 0.05 | 0.67 | 0.54 | 799 | 0.32 |
| *BusSv* | 7.39 | 6.51 | 0.66 | 4249 | 0.09 | 0.70 | 0.57 | 708 | 0.52 |
| *Hardw* | 11.68 | 9.17 | 0.60 | 4508 | 0.13 | 0.70 | 0.55 | 751 | 0.77 |
| *Softw* | 10.94 | 14.42 | 0.61 | 4538 | 0.12 | 0.70 | 0.54 | 756 | 0.72 |
| *Chips* | 10.87 | 8.75 | 0.63 | 4193 | 0.13 | 0.70 | 0.56 | 699 | 0.77 |
| *LabEq* | 8.43 | 6.70 | 0.65 | 4203 | 0.10 | 0.70 | 0.56 | 700 | 0.60 |
| *Paper* | 3.79 | 7.20 | 0.64 | 4831 | 0.04 | 0.67 | 0.54 | 805 | 0.23 |
| *Boxes* | -0.02 | 7.50 | 0.63 | 5026 | 0.00 | 0.67 | 0.53 | 838 | 0.00 |
| *Trans* | 5.18 | 7.31 | 0.64 | 4670 | 0.06 | 0.67 | 0.54 | 778 | 0.33 |
| *Whlsl* | 8.03 | 6.32 | 0.64 | 4185 | 0.10 | 0.70 | 0.56 | 698 | 0.57 |
| *Rtail* | 7.73 | 7.06 | 0.63 | 4272 | 0.09 | 0.70 | 0.56 | 712 | 0.54 |
| *Meals* | 7.25 | 6.60 | 0.64 | 4545 | 0.08 | 0.69 | 0.55 | 758 | 0.48 |
| *Banks* | 4.92 | 4.89 | 0.69 | 4068 | 0.06 | 0.69 | 0.57 | 678 | 0.36 |
| *Insur* | 2.72 | 5.84 | 0.69 | 4419 | 0.03 | 0.68 | 0.57 | 736 | 0.18 |
| *RlEst* | 4.16 | 7.88 | 0.62 | 4918 | 0.04 | 0.67 | 0.52 | 820 | 0.25 |
| *Fin* | 4.48 | 6.52 | 0.68 | 4061 | 0.05 | 0.69 | 0.58 | 677 | 0.33 |
| *Other* | 6.18 | 7.50 | 0.64 | 4537 | 0.07 | 0.69 | 0.54 | 756 | 0.41 |

In terms of achieving MA returns after cost in excess of the BH, the adjusted *BETC*6* for all 49 indices range from -27 to 77 basis points. For the top ten indices listed in Section 3.4.2, the reported *BETC*6* given as basis points are:

*Hardw 77* *Softw 72* *Chips 77* *Oil 62* *Steel 48*

*Autos 50* *Telcm 59* *Rtail 54* *Cnstr 39* *Whlsl 57*

Additionally, when reviewing the 49 indices, it can be seen 14 report a *BETC*6* greater than 50 basis points, with an additional 2 reporting exactly 50. As stated in Section 3.3.4, the academic rule of thumb is to apply a transaction cost of up to 50 basis points per transaction.

Therefore, a considerable number of indices achieve a higher return after cost when accounting for the highest possible cost per transaction.

The above analysis shows the MA is able to achieve returns above the BH after cost is considered. This is especially true for any investor who is able to keep costs to a minimum on a per transaction basis.

## 3.5 Equal versus Value Weighted

The following section compares the performance of the MA for value and equal weighted portfolios found in Section 3.3 and 3.4.

When reviewing the findings for value and equal weighted, it appears equal weighted performance is more consistent than value weighted. This is evidenced by the number of indices with a 50 basis point or higher adjusted *BETC*, with 16 indices for equal versus 2 indices for value.

An interesting finding of note is that the only index to achieve a top ten performance alpha for both value and equal was *Steel*. When reviewing the top ten indices and their MA excess returns over the BH, the top ten alphas for value range from 8.800% to 15.041%, performance differential of 6.242%. Contrast this with the top ten alphas for equal, with an alpha range of 11.292% to 14.131%, differential 2.839%. The performance differential across the top ten is considerably lower for equal. While the highest return in excess of the BH overall is for value weighted *RlEst*, the average excess return after cost across the 49 indices is higher for equal.

The performance differential and average performance of equal versus value can also be seen in Figure 5 and 6. The figures show the alphas for each index with value and equal performance side-by-side. Figure 5 reports the alphas irrespective of statistical significance while Figure 6 alters any alpha not statistically significant with at least 90% confidence to zero. The graphs clearly show higher overall performance for equal relative to value as stated previously.

**Figure 5: Value vs. Equal Weighed Alphas Portfolio Comparison**

This figure does not consider whether the alpha is statistically significant and therefore different from zero.

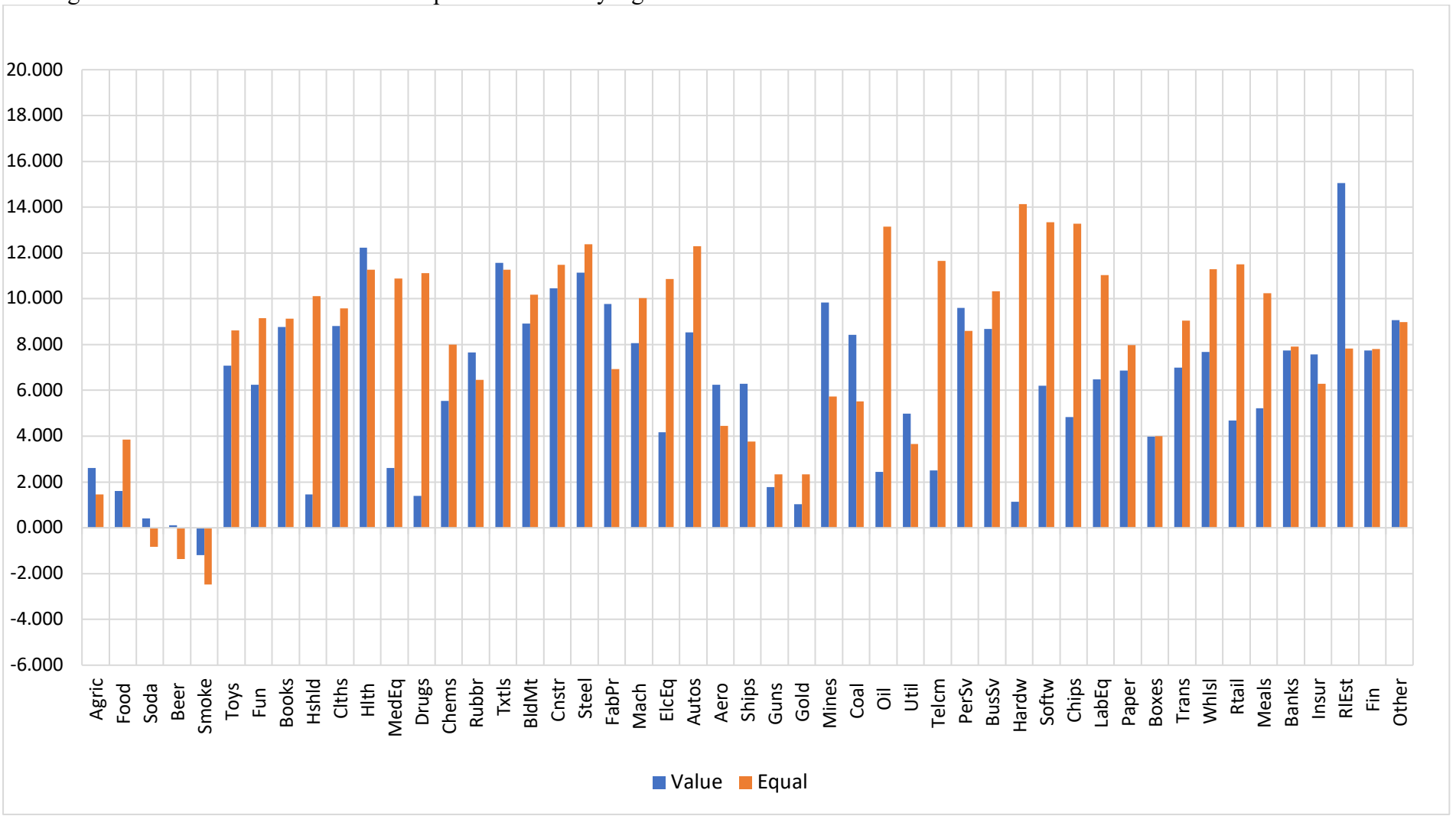
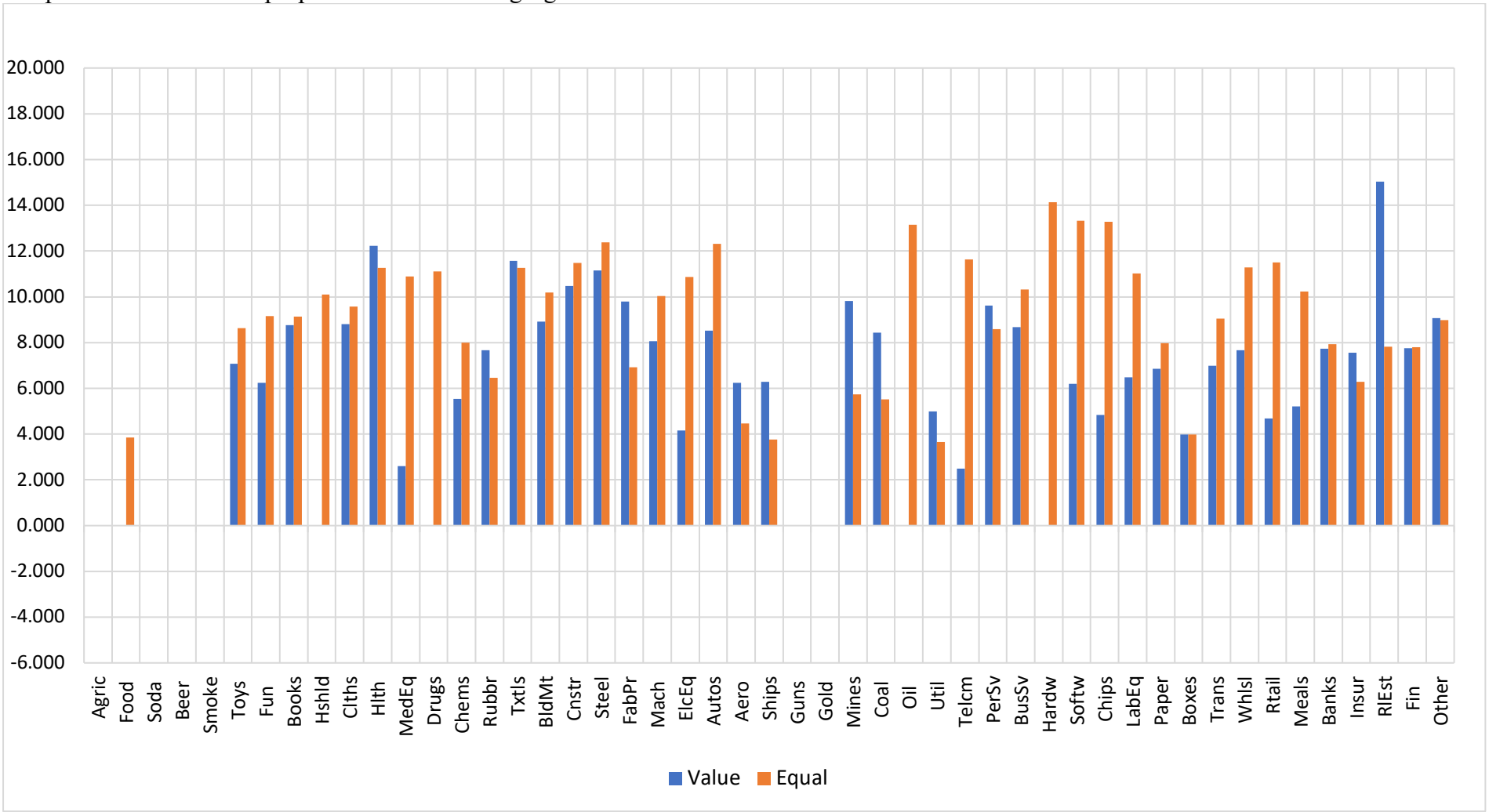


**Figure 6: Value vs. Equal Weighed Alphas Portfolio Comparison**

This figure considers whether the alpha is statistically significant and therefore different from zero. If the alpha was not statistically significant, it is reported as zero for the purposes of the following figure.



A clear standout performance indicator for the MA over the BH is its risk reducing benefits. The risk reduction occurs irrespective of excess return performance and is considerable. The risk reduction for both weighting methods in relation to the standard deviation of returns when using the MA over the BH is significant. For value, the minimum and maximum standard deviation reduction is 5.59% and 16.58% respectively. For equal, the minimum and maximum standard deviation reduction is 4.56% and 16.56% respectively.

Additionally, for value, the *SR* increases by a factor of 80.000 for *RlEst*, 18.667 for *Other* and 6.364 for *PerSv*. For equal, the *SR* increases by a factor of 3.468 for *Softw*, 3.164 for *Hardw* and 3.000 for *Autos* and *Steel*. These represent the top three *SR* improvements across the 49 indices. The lowest changes are 1.154 for *Soda* in value and 1.067 for *Smoke* in equal.

While value contains the highest results for risk reduction for both *SR* and the standard deviation of returns, an investor will increase their risk-return efficiency irrespective of choosing value or equal weighted indices.

When considering all the aforementioned analysis, particularly the excess performance differential and the risk reducing benefits of the MA, it can be concluded equal weighted outperforms value weighted for the MA when investing in Industry indices.

## 3.6 Robustness Checks

The robustness checks in the following section utilise two subperiods to ensure the results reported in Section 3.3 and 3.4 are not a result of data mining. As was the case in the previous sections, the results reported are for model (3) as the other regression results do not add anything to the analysis. The subperiods utilised in this section are July 1, 1969 to June 30, 1995 and July 1, 1995 to October 31, 2018 with daily returns used.

The subperiod regression results are reported in Table 71-72 for value and equal weighted respectively. Additionally, Figure 7-10 show the results graphically for both time horizons. Figure 7-8 reports the alphas regardless of statistical significance for each subperiod. Figure 9-10 reports the same results with any alpha not statistically significant with at least 90% confidence set to zero.

When reviewing the results overall it is clear there is a significant drop in performance for the second subperiod from 1995 to 2018. In particular, the performance decline for value weighted is substantial with only 7 of 49 indices reporting positive statistically significant excess returns for the MA over the BH. Contrast this with the subperiod from 1969 to 1995, with 47 of 49 indices reporting positive statistically significant alphas. Compare these results with equal weighted, with the same result for 1969 to 1995, but an improved result for 1995 to 2018 with 27 of 49 reporting positive statistically significant alphas.

Examining the excess returns for the time period from 1969 to 1995, value weighted range from 3.125% to 19.567% per annum while equal weighted range from 4.216% to 17.236%.

**Table 71: Subperiod Factor Regression Results for Value Weighted US Portfolios by Industry**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | 01 July 1969 to 30 June 1995 | | | | | | 01 July 1995 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
| *Agric* | 6.348*** | -0.495*** | -0.402*** | -0.026 | -0.032* | 0.270 | -1.972 | -0.456*** | 0.006 | -0.090*** | -0.025* | 0.274 |
| *Food* | 6.618*** | -0.463*** | -0.073*** | -0.031** | -0.087*** | 0.518 | -3.644** | -0.326*** | 0.178*** | -0.062*** | -0.017** | 0.393 |
| *Soda* | 3.552* | -0.550*** | 0.126*** | 0.048* | -0.091*** | 0.348 | -3.037 | -0.362*** | 0.158*** | -0.045** | 0.004 | 0.220 |
| *Beer* | 4.417*** | -0.514*** | -0.040** | -0.019 | -0.080*** | 0.411 | -4.130** | -0.310*** | 0.268*** | 0.024* | -0.034*** | 0.270 |
| *Smoke* | 0.605 | -0.468*** | 0.023 | 0.058** | -0.023 | 0.353 | -3.339 | -0.301*** | 0.202*** | -0.032 | -0.027* | 0.137 |
| *Toys* | 11.535*** | -0.753*** | -0.278*** | 0.239*** | -0.003 | 0.502 | 1.370 | -0.527*** | -0.164*** | -0.074*** | 0.042*** | 0.377 |
| *Fun* | 9.089*** | -0.774*** | -0.230*** | 0.147*** | -0.066*** | 0.464 | 3.425 | -0.697*** | -0.162*** | -0.080*** | 0.194*** | 0.478 |
| *Books* | 14.267*** | -0.569*** | -0.173*** | -0.060*** | -0.047*** | 0.512 | 2.121 | -0.599*** | -0.145*** | -0.221*** | 0.054*** | 0.549 |
| *Hshld* | 5.137*** | -0.578*** | 0.135*** | 0.126*** | -0.014 | 0.575 | -3.099 | -0.372*** | 0.183*** | -0.036*** | -0.003 | 0.366 |
| *Clths* | 17.275*** | -0.653*** | -0.386*** | -0.062*** | -0.021 | 0.536 | -0.611 | -0.544*** | -0.112*** | -0.105*** | 0.052*** | 0.470 |
| *Hlth* | 17.327*** | -0.749*** | -0.578*** | 0.371*** | 0.056** | 0.371 | 4.697* | -0.461*** | -0.066*** | -0.086*** | -0.020 | 0.346 |
| *MedEq* | 6.135*** | -0.552*** | -0.082*** | 0.284*** | 0.007 | 0.476 | -2.798 | -0.460*** | -0.008 | 0.016 | -0.032*** | 0.463 |
| *Drugs* | 5.415*** | -0.518*** | 0.040*** | 0.223*** | -0.036** | 0.519 | -3.790** | -0.442*** | 0.138*** | 0.094*** | -0.029*** | 0.446 |
| *Chems* | 8.791*** | -0.596*** | -0.110*** | 0.027 | -0.016 | 0.599 | 1.073 | -0.610*** | 0.074*** | -0.168*** | 0.020* | 0.524 |
| *Rubbr* | 12.297*** | -0.586*** | -0.460*** | -0.044** | -0.077*** | 0.489 | 2.122 | -0.526*** | -0.210*** | -0.218*** | 0.010 | 0.553 |
| *Txtls* | 15.119*** | -0.606*** | -0.428*** | -0.148*** | -0.060*** | 0.511 | 7.698*** | -0.608*** | -0.267*** | -0.323*** | 0.118*** | 0.452 |
| *BldMt* | 13.030*** | -0.621*** | -0.318*** | -0.026 | -0.060*** | 0.610 | 3.610* | -0.605*** | -0.117*** | -0.277*** | 0.027*** | 0.572 |
| *Cnstr* | 18.224*** | -0.755*** | -0.476*** | -0.008 | -0.042*** | 0.538 | 0.410 | -0.783*** | -0.244*** | -0.335*** | 0.005 | 0.559 |
| *Steel* | 15.058*** | -0.691*** | -0.287*** | -0.162*** | -0.043*** | 0.545 | 7.219** | -0.904*** | -0.155*** | -0.087*** | 0.115*** | 0.571 |
| *FabPr* | 10.467*** | -0.591*** | -0.481*** | 0.013 | 0.007 | 0.370 | 8.315*** | -0.627*** | -0.347*** | -0.214*** | 0.103*** | 0.464 |
| *Mach* | 12.672*** | -0.618*** | -0.273*** | 0.040** | -0.024** | 0.619 | 3.045 | -0.714*** | -0.078*** | 0.012 | 0.106*** | 0.631 |
| *ElcEq* | 6.846*** | -0.619*** | -0.109*** | 0.099*** | -0.028** | 0.503 | 0.713 | -0.690*** | -0.022 | -0.003 | 0.064*** | 0.610 |
| *Autos* | 9.280*** | -0.650*** | 0.047*** | -0.164*** | 0.009 | 0.498 | 7.331*** | -0.726*** | -0.037** | -0.256*** | 0.094*** | 0.567 |
| *Aero* | 11.493*** | -0.666*** | -0.235*** | -0.012 | 0.025 | 0.492 | 0.106 | -0.586*** | 0.121*** | -0.077*** | 0.036*** | 0.488 |
| *Ships* | 11.716*** | -0.551*** | -0.293*** | -0.047 | -0.076*** | 0.246 | -0.488 | -0.488*** | -0.087*** | -0.222*** | -0.021* | 0.348 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Guns* | 6.494*** | -0.566*** | -0.108*** | -0.053** | -0.001 | 0.353 | -3.986 | -0.341*** | 0.071*** | -0.162*** | -0.076*** | 0.186 |
| *Gold* | *6.589* | *-0.258**** | *-0.445**** | *0.319**** | *-0.001* | *0.059* | *-6.99* | *-0.286**** | *-0.117**** | *-0.064** | *-0.036* | *0.039* |
| *Mines* | 12.498*** | -0.574*** | -0.304*** | 0.058** | -0.010 | 0.390 | 4.872 | -0.738*** | -0.089*** | -0.289*** | -0.006 | 0.414 |
| *Coal* | 8.043*** | -0.622*** | -0.355*** | -0.049 | -0.009 | 0.258 | 8.133 | -0.905*** | -0.321*** | -0.254*** | 0.086*** | 0.283 |
| *Oil* | 5.974*** | -0.506*** | 0.128*** | -0.041* | 0.017 | 0.451 | -2.492 | -0.587*** | 0.099*** | -0.176*** | -0.020* | 0.402 |
| *Util* | 9.866*** | -0.376*** | -0.066*** | -0.210*** | -0.037*** | 0.478 | -0.097 | -0.364*** | 0.162*** | -0.138*** | -0.028*** | 0.345 |
| *Telcm* | 3.715*** | -0.414*** | 0.090*** | -0.185*** | -0.047*** | 0.418 | 1.969 | -0.582*** | 0.161*** | 0.019 | 0.092*** | 0.585 |
| *PerSv* | 17.154*** | -0.681*** | -0.488*** | 0.145*** | -0.029 | 0.461 | 0.525 | -0.535*** | -0.189*** | -0.062*** | -0.001 | 0.464 |
| *BusSv* | 14.805*** | -0.645*** | -0.413*** | 0.046*** | -0.050*** | 0.624 | 2.026 | -0.597*** | -0.090*** | 0.037*** | 0.040*** | 0.666 |
| *Hardw* | 4.023** | -0.588*** | 0.215*** | 0.370*** | 0.015 | 0.519 | -0.436 | -0.730*** | 0.023 | 0.651*** | 0.285*** | 0.548 |
| *Softw* | 13.972*** | -0.998*** | -0.826*** | 0.281*** | 0.138*** | 0.212 | -1.144 | -0.711*** | -0.017 | 0.500*** | 0.109*** | 0.619 |
| *Chips* | 10.718*** | -0.663*** | -0.217*** | 0.234*** | 0.019 | 0.592 | 0.551 | -0.781*** | -0.038** | 0.611*** | 0.267*** | 0.591 |
| *LabEq* | 11.270*** | -0.651*** | -0.134*** | 0.245*** | -0.003 | 0.496 | 1.694 | -0.659*** | -0.156*** | 0.294*** | 0.149*** | 0.624 |
| *Paper* | 11.441*** | -0.581*** | -0.168*** | -0.067*** | -0.040*** | 0.523 | 1.593 | -0.507*** | 0.081*** | -0.179*** | 0.015* | 0.544 |
| *Boxes* | 3.125* | -0.528*** | -0.038*** | 0.056*** | -0.040*** | 0.447 | 4.218* | -0.551*** | -0.050*** | -0.160*** | 0.004 | 0.477 |
| *Trans* | 13.450*** | -0.698*** | -0.325*** | -0.008 | 0.000 | 0.595 | -0.850 | -0.556*** | -0.065*** | -0.170*** | 0.032*** | 0.541 |
| *Whlsl* | 11.816*** | -0.597*** | -0.402*** | 0.092*** | -0.014 | 0.593 | 2.766* | -0.494*** | -0.081*** | -0.070*** | 0.029*** | 0.584 |
| *Rtail* | 11.434*** | -0.611*** | -0.134*** | 0.051*** | -0.073*** | 0.591 | -2.458 | -0.518*** | 0.093*** | 0.028** | 0.010 | 0.489 |
| *Meals* | 11.455*** | -0.731*** | -0.259*** | 0.199*** | 0.040** | 0.502 | -2.382 | -0.425*** | 0.053*** | -0.043*** | 0.015* | 0.419 |
| *Banks* | 13.060*** | -0.604*** | -0.157*** | -0.113*** | -0.002 | 0.550 | -0.140 | -0.773*** | 0.080*** | -0.629*** | 0.154*** | 0.651 |
| *Insur* | 12.224*** | -0.549*** | -0.234*** | -0.035** | -0.013 | 0.545 | 1.050 | -0.622*** | 0.122*** | -0.365*** | 0.053*** | 0.616 |
| *RlEst* | 19.576*** | -0.699*** | -0.687*** | -0.048* | 0.006 | 0.412 | 8.799*** | -0.692*** | -0.371*** | -0.465*** | 0.110*** | 0.517 |
| *Fin* | 12.210*** | -0.575*** | -0.256*** | -0.047*** | 0.018* | 0.615 | 2.289 | -0.890*** | 0.027 | -0.168*** | 0.182*** | 0.650 |
| *Other* | 14.709*** | -0.703*** | -0.385*** | 0.096*** | -0.010 | 0.325 | 3.026 | -0.584*** | 0.053*** | -0.064*** | 0.137*** | 0.493 |

**Table 72: Subperiod Factor Regression Results for Value Weighted US Portfolios by Industry**

Subperiod results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h].

| | 01 July 1969 to 30 June 1995 | | | | | | 01 July 1995 to 31 October 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
| *Agric* | 5.381** | -0.444*** | -0.514*** | -0.026 | 0.055*** | 0.208 | -4.299* | -0.390*** | -0.243*** | -0.155*** | 0.008 | 0.257 |
| *Food* | 8.844*** | -0.403*** | -0.376*** | -0.061*** | -0.055*** | 0.551 | -1.780 | -0.312*** | -0.110*** | -0.142*** | 0.008 | 0.471 |
| *Soda* | 4.216** | -0.483*** | -0.332*** | -0.115*** | -0.072*** | 0.265 | -5.983*** | -0.309*** | -0.048*** | -0.088*** | -0.012 | 0.193 |
| *Beer* | 5.762*** | -0.467*** | -0.406*** | -0.052*** | -0.037*** | 0.373 | -8.719*** | -0.248*** | -0.012 | -0.031*** | 0.000 | 0.199 |
| *Smoke* | 1.699 | -0.433*** | -0.249*** | 0.001 | -0.027 | 0.197 | -7.391*** | -0.281*** | -0.007 | -0.060*** | -0.010 | 0.129 |
| *Toys* | 12.880*** | -0.602*** | -0.658*** | -0.038* | 0.044*** | 0.487 | 3.596* | -0.399*** | -0.229*** | -0.102*** | 0.050*** | 0.357 |
| *Fun* | 10.494*** | -0.545*** | -0.589*** | 0.007 | 0.037*** | 0.455 | 7.035*** | -0.477*** | -0.298*** | -0.145*** | 0.079*** | 0.515 |
| *Books* | 11.099*** | -0.435*** | -0.417*** | -0.037** | -0.014 | 0.497 | 5.846*** | -0.523*** | -0.346*** | -0.312*** | 0.083*** | 0.531 |
| *Hshld* | 13.996*** | -0.539*** | -0.524*** | -0.039** | 0.004 | 0.602 | 5.284*** | -0.437*** | -0.244*** | -0.185*** | 0.054*** | 0.558 |
| *Clths* | 15.109*** | -0.523*** | -0.558*** | -0.131*** | 0.017 | 0.543 | 3.252 | -0.446*** | -0.295*** | -0.180*** | 0.048*** | 0.475 |
| *Hlth* | 15.751*** | -0.599*** | -0.716*** | 0.242*** | 0.050** | 0.348 | 4.591** | -0.391*** | -0.249*** | -0.102*** | 0.016* | 0.459 |
| *MedEq* | 14.570*** | -0.607*** | -0.660*** | 0.114*** | -0.004 | 0.573 | 6.096*** | -0.391*** | -0.283*** | -0.019* | 0.028*** | 0.514 |
| *Drugs* | 11.164*** | -0.591*** | -0.516*** | 0.113*** | -0.075*** | 0.572 | 10.864*** | -0.528*** | -0.397*** | 0.139*** | 0.042*** | 0.529 |
| *Chems* | 9.871*** | -0.503*** | -0.448*** | -0.017 | -0.016 | 0.588 | 4.925** | -0.545*** | -0.230*** | -0.232*** | 0.040*** | 0.565 |
| *Rubbr* | 9.287*** | -0.480*** | -0.589*** | -0.060*** | 0.032*** | 0.463 | 2.638 | -0.438*** | -0.261*** | -0.223*** | 0.048*** | 0.480 |
| *Txtls* | 14.813*** | -0.543*** | -0.541*** | -0.164*** | 0.007 | 0.520 | 7.268*** | -0.442*** | -0.314*** | -0.243*** | 0.061*** | 0.380 |
| *BldMt* | 13.621*** | -0.506*** | -0.548*** | -0.063*** | 0.023** | 0.599 | 5.387*** | -0.478*** | -0.297*** | -0.223*** | 0.055*** | 0.600 |
| *Cnstr* | 15.560*** | -0.600*** | -0.616*** | -0.058*** | 0.012 | 0.508 | 5.303** | -0.626*** | -0.402*** | -0.377*** | 0.036*** | 0.545 |
| *Steel* | 13.378*** | -0.539*** | -0.488*** | -0.094*** | -0.003 | 0.572 | 10.419*** | -0.704*** | -0.373*** | -0.304*** | 0.107*** | 0.583 |
| *FabPr* | 10.646*** | -0.483*** | -0.528*** | -0.103*** | -0.011 | 0.399 | 1.772 | -0.552*** | -0.393*** | -0.295*** | 0.073*** | 0.372 |
| *Mach* | 13.534*** | -0.517*** | -0.532*** | -0.013 | 0.015 | 0.632 | 5.529*** | -0.590*** | -0.304*** | -0.150*** | 0.095*** | 0.641 |
| *ElcEq* | 12.666*** | -0.534*** | -0.595*** | -0.012 | 0.036*** | 0.559 | 7.825*** | -0.513*** | -0.324*** | -0.115*** | 0.073*** | 0.572 |
| *Autos* | 13.691*** | -0.592*** | -0.515*** | -0.075*** | 0.021* | 0.582 | 9.990*** | -0.627*** | -0.339*** | -0.311*** | 0.108*** | 0.594 |
| *Aero* | 10.102*** | -0.607*** | -0.542*** | -0.032 | 0.032** | 0.473 | -2.334 | -0.462*** | -0.145*** | -0.179*** | 0.030*** | 0.450 |
| *Ships* | 7.723*** | -0.541*** | -0.516*** | -0.105*** | -0.083*** | 0.186 | -1.009 | -0.565*** | -0.348*** | -0.298*** | 0.072*** | 0.461 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Guns* | 5.736*** | -0.534*** | -0.395*** | -0.088*** | -0.072*** | 0.243 | -1.846 | -0.378*** | -0.211*** | -0.199*** | -0.044*** | 0.277 |
| *Gold* | *6.934*** | *-0.288**** | *-0.537**** | *0.104*** | *-0.032* | *0.084* | *-4.152* | *-0.340**** | *-0.265**** | *-0.121**** | *-0.014* | *0.059* |
| *Mines* | 6.380*** | -0.467*** | -0.561*** | 0.034 | -0.022 | 0.287 | 3.716 | -0.567*** | -0.270*** | -0.250*** | 0.022 | 0.330 |
| *Coal* | -4.487 | -0.557*** | -0.523*** | 0.041 | -0.024 | 0.158 | 15.560*** | -0.824*** | -0.455*** | -0.430*** | 0.176*** | 0.272 |
| *Oil* | 13.451*** | -0.495*** | -0.485*** | 0.119*** | 0.090*** | 0.461 | 10.468*** | -0.644*** | -0.311*** | -0.302*** | 0.129*** | 0.392 |
| *Util* | 8.175*** | -0.299*** | -0.164*** | -0.166*** | -0.033*** | 0.493 | -1.415 | -0.345*** | 0.018* | -0.158*** | -0.010 | 0.414 |
| *Telcm* | 11.620*** | -0.507*** | -0.491*** | 0.038** | -0.002 | 0.544 | 11.988*** | -0.610*** | -0.320*** | 0.087*** | 0.152*** | 0.581 |
| *PerSv* | 12.270*** | -0.535*** | -0.612*** | 0.000 | 0.000 | 0.431 | 3.568* | -0.457*** | -0.331*** | -0.145*** | 0.040*** | 0.501 |
| *BusSv* | 14.494*** | -0.539*** | -0.620*** | 0.040** | 0.030*** | 0.598 | 4.975*** | -0.453*** | -0.287*** | -0.031*** | 0.043*** | 0.607 |
| *Hardw* | 17.236*** | -0.708*** | -0.657*** | 0.208*** | 0.030** | 0.618 | 11.041*** | -0.600*** | -0.375*** | 0.231*** | 0.158*** | 0.599 |
| *Softw* | 15.630*** | -0.775*** | -0.896*** | 0.117** | 0.198*** | 0.170 | 10.588*** | -0.566*** | -0.377*** | 0.238*** | 0.079*** | 0.599 |
| *Chips* | 16.229*** | -0.646*** | -0.709*** | 0.095*** | 0.037*** | 0.624 | 10.815*** | -0.615*** | -0.362*** | 0.259*** | 0.160*** | 0.618 |
| *LabEq* | 15.708*** | -0.539*** | -0.600*** | 0.055*** | 0.017 | 0.573 | 5.353*** | -0.482*** | -0.285*** | 0.057*** | 0.090*** | 0.592 |
| *Paper* | 10.228*** | -0.460*** | -0.414*** | -0.076*** | -0.015 | 0.530 | 4.551** | -0.545*** | -0.241*** | -0.312*** | 0.065*** | 0.572 |
| *Boxes* | 5.236*** | -0.472*** | -0.459*** | -0.048*** | 0.003 | 0.392 | 2.002 | -0.537*** | -0.207*** | -0.191*** | 0.003 | 0.465 |
| *Trans* | 12.524*** | -0.541*** | -0.525*** | -0.025 | 0.042*** | 0.576 | 4.119** | -0.528*** | -0.305*** | -0.248*** | 0.067*** | 0.585 |
| *Whlsl* | 15.608*** | -0.494*** | -0.576*** | -0.005 | 0.033*** | 0.569 | 5.763*** | -0.453*** | -0.276*** | -0.130*** | 0.028*** | 0.599 |
| *Rtail* | 15.885*** | -0.510*** | -0.522*** | -0.076*** | -0.023** | 0.622 | 6.405*** | -0.532*** | -0.312*** | -0.147*** | 0.066*** | 0.590 |
| *Meals* | 14.735*** | -0.586*** | -0.599*** | 0.002 | 0.044*** | 0.554 | 4.833*** | -0.391*** | -0.232*** | -0.169*** | 0.064*** | 0.490 |
| *Banks* | 11.569*** | -0.405*** | -0.396*** | -0.100*** | 0.036*** | 0.543 | 2.789** | -0.332*** | -0.171*** | -0.302*** | 0.043*** | 0.572 |
| *Insur* | 10.783*** | -0.409*** | -0.406*** | -0.018 | 0.026*** | 0.526 | -0.240 | -0.472*** | -0.119*** | -0.297*** | 0.039*** | 0.559 |
| *RlEst* | 12.489*** | -0.555*** | -0.669*** | -0.081*** | 0.130*** | 0.409 | 1.330 | -0.481*** | -0.304*** | -0.340*** | 0.088*** | 0.451 |
| *Fin* | 11.720*** | -0.404*** | -0.430*** | -0.035*** | 0.073*** | 0.549 | 2.093 | -0.507*** | -0.242*** | -0.232*** | 0.081*** | 0.615 |
| *Other* | 14.892*** | -0.581*** | -0.658*** | 0.026 | 0.038** | 0.324 | 1.558 | -0.352*** | -0.217*** | -0.076*** | 0.001 | 0.428 |

**Figure 7: Subperiod Value vs. Equal Weighed Alphas Portfolio Comparison**

The subperiod is July 1965 to June 1995. This figure does not consider whether the alpha is statistically significant and therefore different from zero.

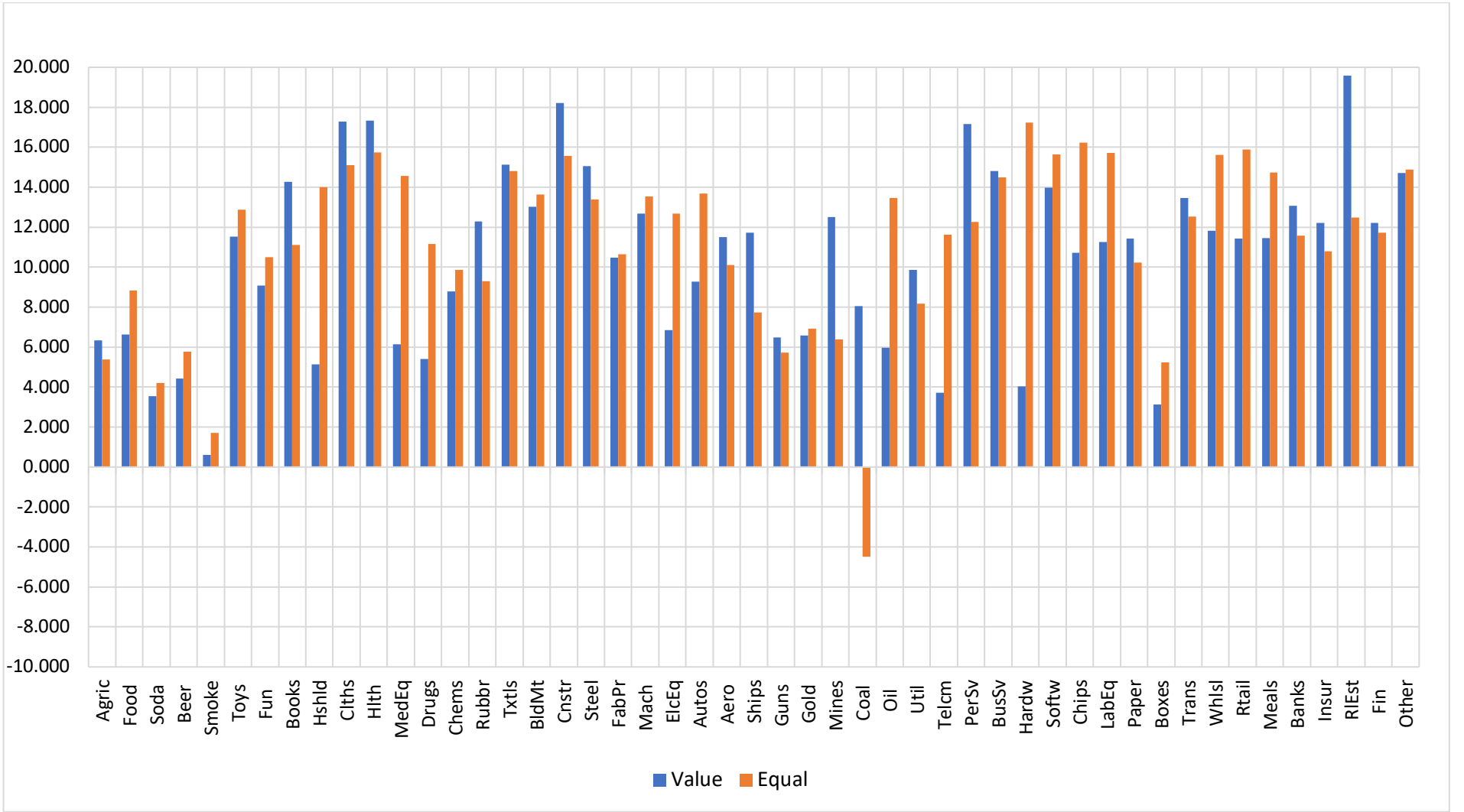


**Figure 8: Subperiod Value vs. Equal Weighed Alphas Portfolio Comparison**

The subperiod is July 1965 to June 1995. This figure considers whether the alpha is statistically significant and therefore different from zero. If the alpha was not statistically significant, it is reported as zero for the purposes of the following figure.

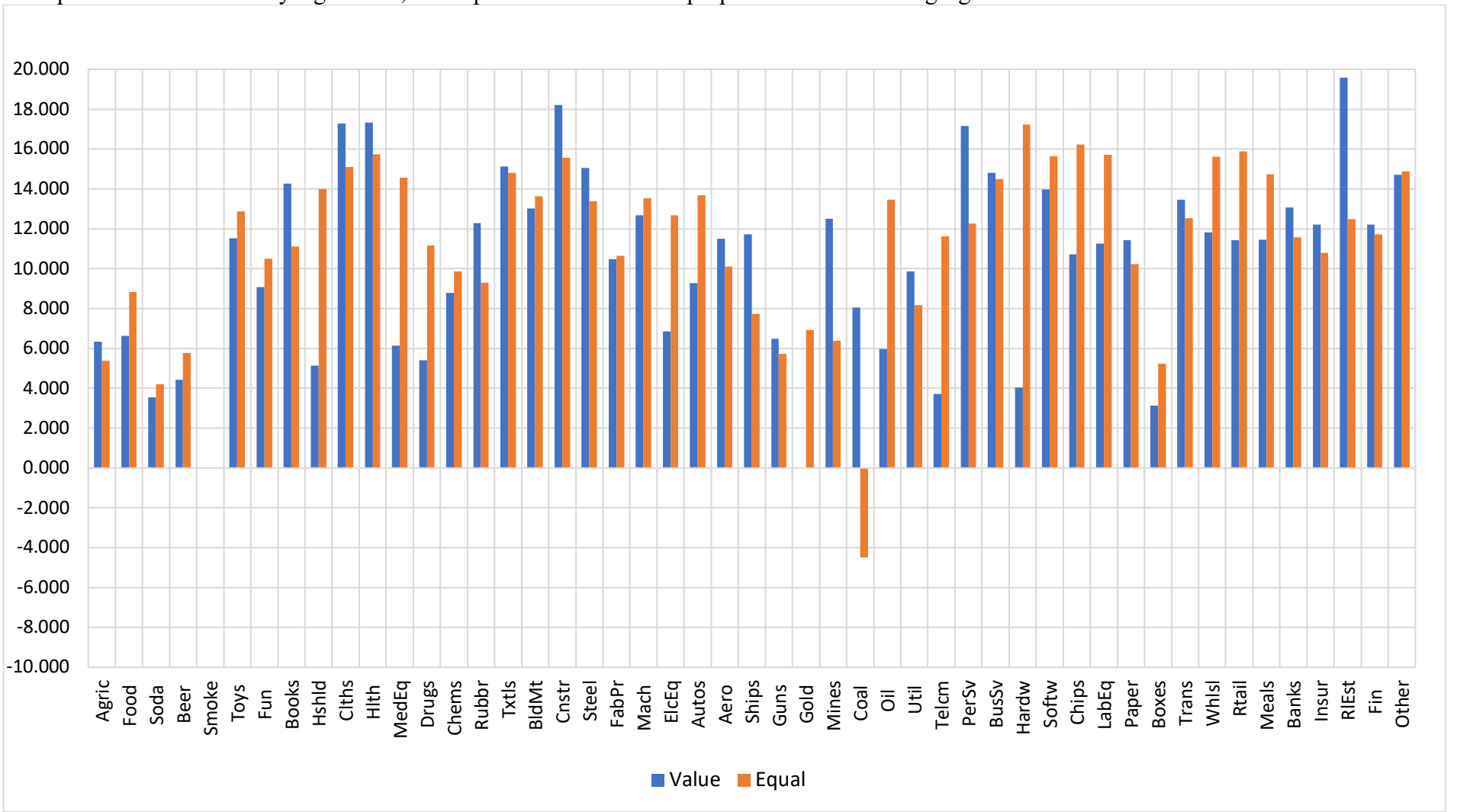


**Figure 9: Subperiod Value vs. Equal Weighed Alphas Portfolio Comparison**

The subperiod is July1995 to October 2018. This figure does not consider whether the alpha is statistically significant and therefore different from zero.

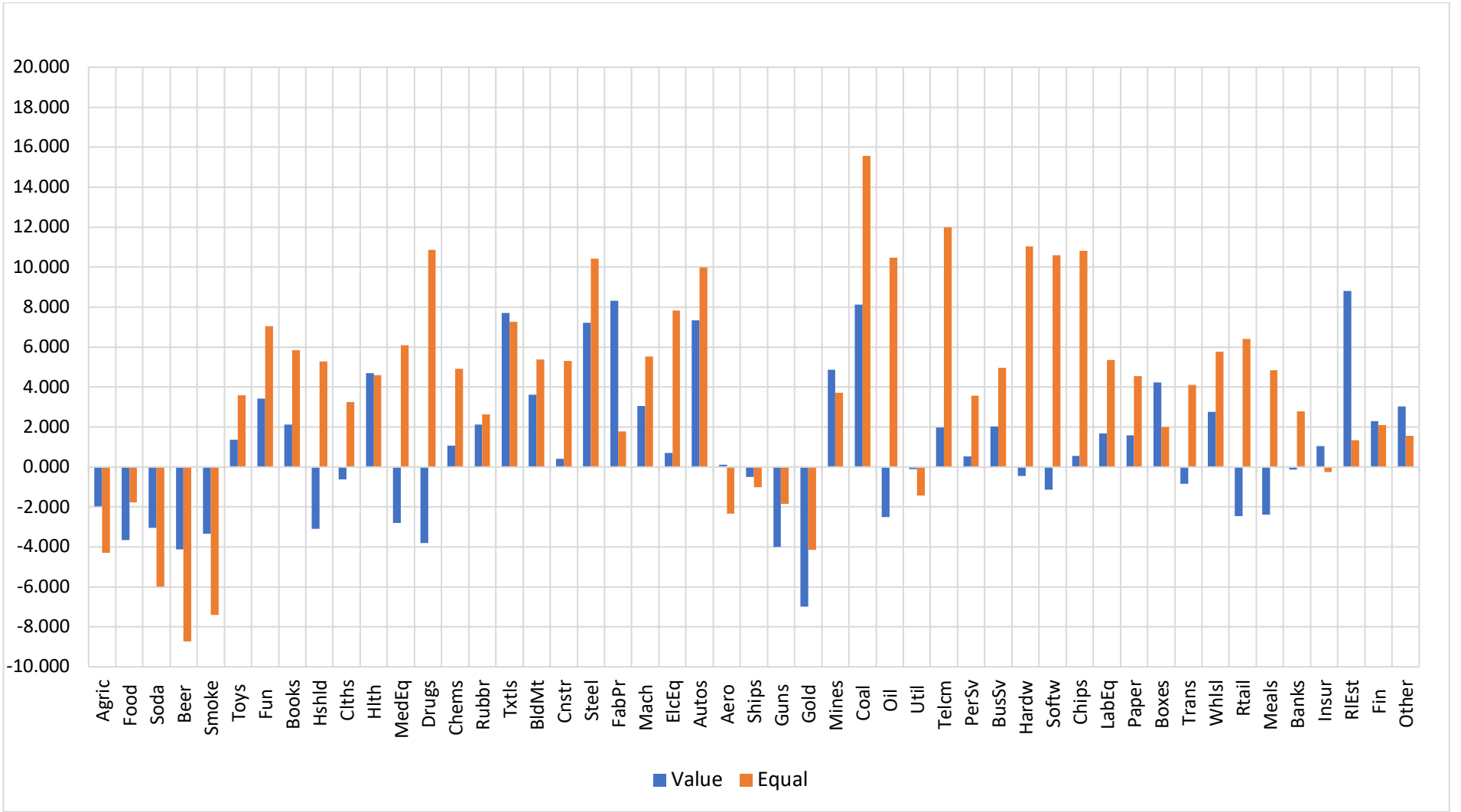
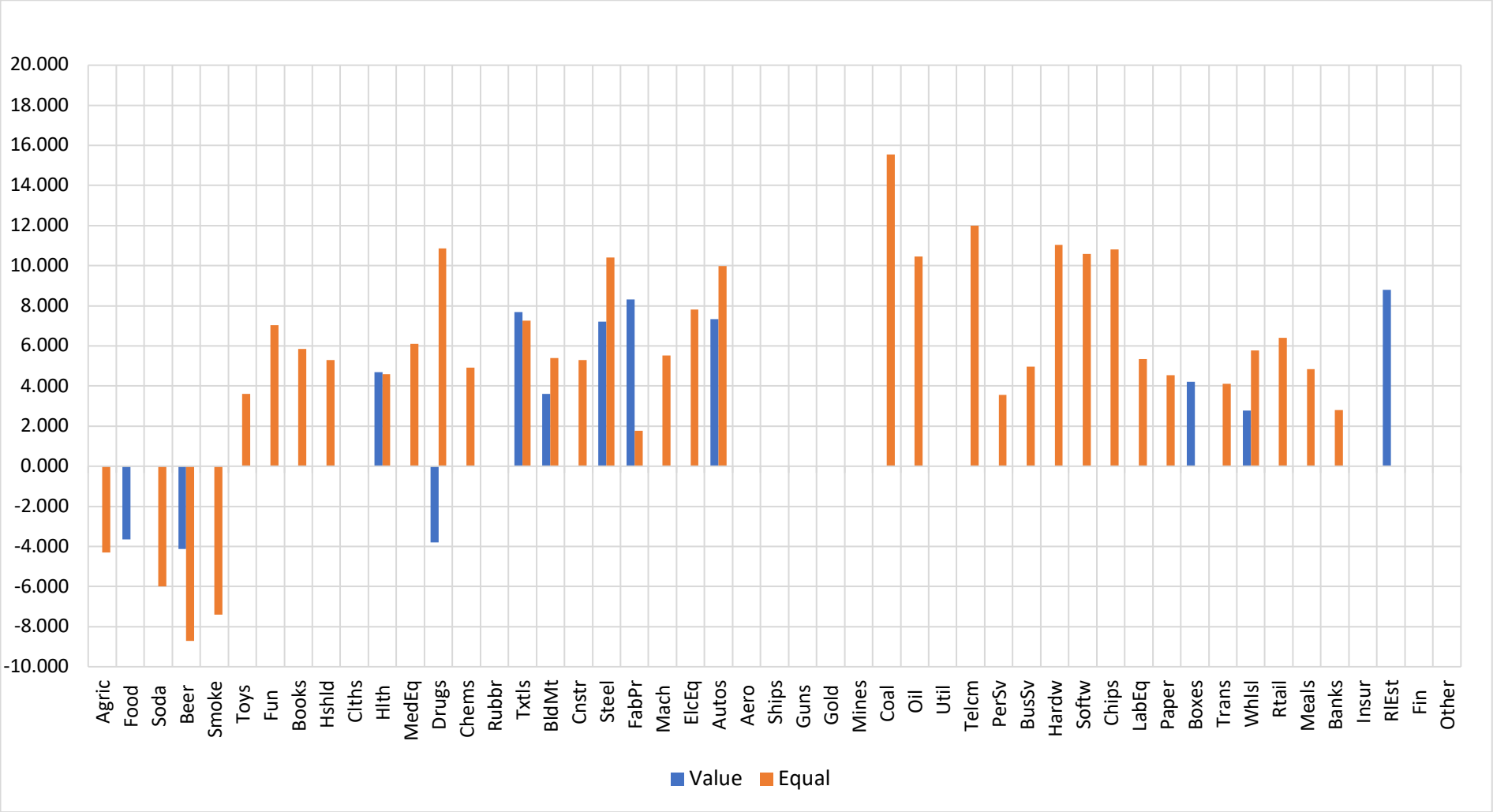


**Figure 10: Subperiod Value vs. Equal Weighed Alphas Portfolio Comparison**

The subperiod is July1995 to October 2018. This figure considers whether the alpha is statistically significant and therefore different from zero. If the alpha was not statistically significant, it is reported as zero for the purposes of the following figure.



The breakdown performance of the top ten for value from 1965 to 1995 is as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *RlEst* | *19.576%* | *Cnstr* | *18.224%* | *Hlth* | *17.327%* | *Clths* | *17.275%* |
| *PerSv* | *17.154%* | *Txtls* | *15.119%* | *Steel* | *15.058%* | *BusSv* | *14.805%* |
| *Other* | *14.709%* | *Books* | *14.267%* | | | | |

The breakdown performance of the top ten for equal from 1965 to 1995 is as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Hardw* | *17.236%* | *Chips* | *16.229%* | *Rtail* | *15.885%* | *Hlth* | *15.751%* |
| *LabEq* | *15.708%* | *Softw* | *15.630%* | *Whlsl* | *15.608%* | *Cnstr* | *15.560%* |
| *Clths* | *15.109%* | *Other* | *14.892%* | | | | |

As can be seen the performance for both value and equal are quite similar for the first subperiod. However, as stated previously the performance decreases for the subperiod from 1995 to 2018. The performance drop is far more pronounced for value weighted.

The breakdown performance of the top ten for value from 1995 to 2018 is as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *RlEst* | *8.799%* | *FabPr* | *8.315%* | *Coal* | *8.133%* | *Txtls* | *7.698%* |
| *Autos* | *7.331%* | *Steel* | *7.219%* | *Mines* | *4.872%* | *Hlth* | *4.697%* |
| *Boxes* | *4.218%* | *BldMt* | *3.160%* | | | | |

The breakdown performance of the top ten for equal from 1995 to 2018 is as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Coal* | *15.560%* | *Telcm* | *11.988%* | *Hardw* | *11.041%* | *Drugs* | *10.864%* |
| *Chips* | *10.815%* | *Softw* | *10.588%* | *Oil* | *10.468%* | *Steel* | *10.419%* |
| *Autos* | *9.990%* | *ElcEq* | *7.825%* | | | | |

The performance drop off can also be seen graphically in Figure 7-10. Particular attention should be paid to Figure 10, with very few value weighted indices achieving statistically significant results as stated previously.

Overall, the findings reported show there is a sizeable performance drop off between the two sub-periods. The performance drop off is so large, it is reasonable to assume for Industry indices, the current market is too efficient to ensure consistent outperformance of the MA over the BH after costs.

## 3.7 Conclusion

As stated in Section 1.3 and Section 1.4 and the results analysed in Section 2, the MA has the ability to outperform the BH after cost. However, one of the findings in Section 2 was the considerable decline in performance for the MA through time, particularly for the North America Index. The results appeared to indicate the North American market had become more efficient in recent years, blunting the effectiveness of the MA. As stated in Section 2.7, the sheer size and volume traded of the US market has a significant effect on overall market efficiency.

The results reported and analysed in Section 3 show a sizable performance drop in almost all industries for the MA excess return across the two subperiods, supporting the findings in Section 2. While the second subperiod in Section 3 is almost the entirety of the time horizon used in Section 2, there is a clear correlation between time and MA performance. The more recent the time period, the lower the reported performance differentials between the MA and BH.

Interestingly, the equal weighted indices do appear to achieve more consistent results, although still a decrease, for the MA over the most recent subperiod. As such, equal vastly outperforms value from 1995 to 2018 for the Industry indices.

Recall in Section 2 it was found size and MA performance are negatively related. This is supported by the findings of Paskalis (2017). Thus, when jointly reviewing this conclusion with the outperformance of equal versus value for Industry indices, it would appear the equal weighted indices are capturing more of the small-cap performance. This is an expected inference given using equal weighted for each Industry index will increase the weight in small-caps and decrease the weight in large-caps relative to value.

Overall, findings in Section 3 underline the effectiveness of the MA and its ability to achieve performance benefits for investors relative to the BH is reducing through time. This indicates while the MA can and has been an effective trading strategy, it may not be appropriate to use it on its own, especially in recent times. It is likely combining the MA with fundamental analysis can achieve a more consistent result.

# 4.0 Cryptocurrency, Volatility Indices and the Moving Average

## 4.1 Introduction

A key finding in Han, Yang and Zhou (2013) and Glabadanidis (2017) is the positive relationship between volatility and Moving Average (MA) performance, with returns following an imperfect protective put strategy (Glabadanidis 2017). Given the nature of this relationship the purpose of research in this section is to analyse the MA performance against two asset types with a relationship to high volatility, cryptocurrency and volatility indices.

Regarding cryptocurrency, the Reserve Bank of Australia states it is "… a type of digital currency that allows people to make payments directly to each other through an online system. Cryptocurrencies have no legislated or intrinsic value; they are simply worth what people are willing to pay for them in the market." The essential point is that cryptocurrencies have zero intrinsic value and as such, are a purely speculative asset. Given investor sentiment completely drives its value, its price exhibits extreme levels of volatility.

Therefore, given the MA and its relationship to volatility, it is not unreasonable to assume the MA can achieve significant performance gains over the Buy-and-Hold (BH) for such a volatile asset. Should the results for the combination moving average (CMA) achieve statistically significant results it would support the findings of Detzel et al. (2021), finding statistically significant excess returns using 1-20 week MAs, with the Sharpe ratio improving against the BH strategy.

Volatility in the market is also represented by volatility indices. The indices attempt to discern the future 30-day investor implied volatility using options. The higher the implied volatility, the higher the index value; the lower the implied volatility, the lower the index value.

Given volatility indices attempt to predict future volatility over a 30-day window and the relationship MA has with volatility, it is possible the MA could be used to predict index value fluctuations based on future volatility predictions.

The purpose of research in Section 4 is to analyse the MA performance on cryptocurrencies and volatility indices. The cryptocurrencies and indices used can be seen in Section 4.2.

## 4.2 Cryptocurrency and Volatility Index Data

The data used in Section 4 relate to the top four cryptocurrencies by market cap as of October 31, 2018 and the three main US market volatility indices. The data used was sourced from the financial information database Datastream.

The four cryptocurrencies analysed are Bitcoin (*BTC*), Bitcoin Cash (*BCH*), Ethereum (*ETH*) and Ripple (*XRP*). The maximum time horizon was used for each. The performance analysis of the MA is calculated for *BTC* for the time horizon of July 19, 2010 to October 31, 2018, *BCH* for August 7, 2015 to October 31, 2018, *ETH* for August 7, 2015 to October 31, 2018 and *XRP* for January 22, 2015 to October 31, 2018 with daily returns used. Due to using the maximum time horizon for each, MA performance will not be compared across each cryptocurrency. Instead, each will be analysed individually.

The three volatility indices analysed are CBOE Volatility Index (*VIX*), CBOE S&P100 Volatility Index (*VXO*) and Nasdaq Volatility Index (*VXN*). Each index derives its value from the implied volatility of options traded, with *VIX* linked to the S&P500 (*SPX*), *VXO* linked to the S&P100 (*OEX*) and *VXN* linked to the Nasdaq100 (*NDX*).

The performance analysis of the MA is calculated for *VIX* from January 3, 1990 to October 31, 2018, *VXO* from January 3, 1986 to October 31, 2018 and *VXN* for January 24, 2001 to October 31, 2018 with daily returns used. As with the data for the cryptocurrencies, the maximum time horizon was used for each index. As such, MA performance is analysed for each individually.

It should be noted, it is not possible to directly invest into volatility indices. The only access investors have is via futures contracts deriving their value from the volatility index. However,

analysis of the MA will still take place on the index directly, as it will give an indication of the MAs ability to predict future market implied volatility.

The aforementioned data is used to determine the CMA and TIS as per Section 1.5 for each cryptocurrency and index. Regression analysis is then performed on the TIS following the methodology in Section 1.6. As in Section 2 and 3, the regression factors used in the regression models are all sourced from the Kenneth R. French Data Library.

Section 4.3 contains the MA results and analysis for the cryptocurrencies. Section 4.4 contains the MA results and analysis for the volatility indices.

## 4.3 Results - Cryptocurrency

The following section reports and analyses the results for cryptocurrencies. Section 4.3.1 contains the summary statistics and regression results. Section 4.3.2 contains the market timing results and trading statistics.

### 4.3.1 Summary Statistics & Regression Analysis

The following section contains the summary statistics in Table 73 and regression results in Table 74 for the top four cryptocurrency assets *BCH*, *BTC*, *ETH* and *XRP*.

The summary statistics report five statistics for the BH, MA and TIS portfolios: the mean return ($\mu$), standard deviation of returns ($\sigma$), skewness ($s$), kurtosis ($k$) and the Sharpe Ratio ($SR$). The $SR$ is found by $(\mu - r_f)/\sigma$ where $\mu$ is the mean return, $r_f$ is the risk-free return and $\sigma$ is the standard deviation of returns.

The regression results are found using model (1), (2) and (3) from Section 1.6 with only model (3) reported and analysed as the other results do not add to the analysis. Statistical significance tests at the 90%, 95% and 99% confidence level are used, corresponding to *, ** and *** respectively.

The summary statistics in Table 73 show the MA only increases the mean return for *BCH* and *ETH*, with a sizeable increase for *BCH* from -2.54% to 51.32%. The risk reducing benefits of the MA are extremely high, with *SR* increasing by a factor of 1.70 for *BTC*, 36 and becomes positive for *BCH*, 1.91 for *ETH* and 1.36 for *XRP*. These are substantial gains for the risk-return profile of cryptocurrency, especially given the inherent volatility in this asset class.

**Table 73: Summary Statistics for Cryptocurrency**

Cryptocurrency assets where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Currency* | $\mu$ | $\sigma$ | $s$ | $k$ | $SR$ | $\mu$ | $\sigma$ | $s$ | $k$ | $SR$ | $\mu$ | $\sigma$ | $s$ | $k$ | $SR$ |
| BTC | 140.77 | 122.71 | 2.80 | 76.61 | 1.14 | 137.39 | 70.51 | 2.17 | 30.35 | 1.94 | -3.38 | 87.18 | -7.07 | 283.26 | -0.04 |
| BCH | -2.54 | 171.85 | 0.6 | 7.53 | -0.02 | 51.32 | 69.46 | 1.94 | 17.75 | 0.72 | 53.86 | 131.24 | -0.18 | 11.43 | 0.41 |
| ETH | 128.34 | 150.93 | -0.66 | 16.08 | 0.85 | 149.09 | 91.34 | 1.51 | 12.93 | 1.62 | 20.75 | 99.18 | 3.39 | 63.09 | 0.21 |
| XRP | 88.05 | 198.72 | 0.15 | 21.10 | 0.44 | 62.53 | 103.70 | 3.45 | 41.32 | 0.60 | -25.52 | 149.03 | -0.04 | 38.38 | -0.17 |

**Table 74: Factor Regression Results for Cryptocurrency**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where $f$ is the fixed percentage difference, $d$ is the fixed number of days crossed and $h$ is the minimum number of days held.

| *Currency* | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|
| BTC | -5.936 | 0.076 | -0.155 | -0.334 | 0.177 | 0.002 |
| BCH | 47.248 | 0.746 | -0.779 | 1.436 | 0.511 | 0.014 |
| ETH | 19.696 | 0.075 | 0.140 | -0.089 | 0.211 | 0.001 |
| XRP | -22.231 | -0.254 | -0.210 | 0.658 | 0.216 | 0.002 |

The regression results in Table 74 show none of the results pertaining to the excess return differential between the MA and BH are statistically significant. The results indicate an $R^2$ of between 0.001 and 0.014 for all cryptocurrencies. This result emphasises how cryptocurrency does not appear to observe standard expectations regarding investment risk fundamentals, with no clear correlation to any of the regression models four factors: systematic risk, size, book-to-market and momentum. In the absence of statistical significance, it is not possible to conclude if the MA was able to achieve a risk adjusted positive excess return over the BH.

### 4.3.2 Market Timing & Trading Statistics

The following section contains the market timing results in Table 75 and trading statistics in Table 76 for the top four cryptocurrency assets *BCH*, *BTC*, *ETH* and *XRP*.

Given the results in Section 4.3.1 the expectation is the market timing results would report nothing of note. However, the market timing results in Table 75 report *ETH* and *XRP* show the presence of market timing, with *ETH* only providing evidence using the Treynor-Mazuy method with *XRP* for both. These market timing results should be taken with caution given the regression results from Table 74, which reported the cryptocurrencies have zero correlation with any fundamental risk factors and have statistically insignificant alphas.

The trading statistics in Table 76 provide far more meaningful information, especially when coupled with the summary statistics discussed in Section 4.3.1. As can be seen, the MA considerably reduces the overall risk an investor takes relative to the BH with the standard deviation reducing per annum by 52.19% for *BTC*, 102.39% for *BCH*, 59.60% for *ETH* and 95.02% for *XRP*. This explains the sizable increases in *SR* reported in the previous section.

**Table 75: Market Timing Results for Cryptocurrency**

| | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|
| *Currency* | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| BTC | 8.062 | 0.009 | -0.054 | 0.000 | -19.947 | 0.132 | 0.200 | 0.000 |
| BHC | 83.756 | 0.533 | -0.204 | 0.007 | 72.300 | 0.503 | -0.356 | 0.005 |
| ETH | -21.174 | 0.181 | 0.223* | 0.003 | -35.508 | 0.490 | 0.764 | 0.001 |
| XRP | -94.375 | -0.112 | 0.406*** | 0.005 | -151.660* | 0.675 | 1.785** | 0.004 |

**Table 76: Summary Trading Statistics for Cryptocurrency**

| *Currency* | $\Delta\mu$ | $\Delta\sigma$ | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|
| BTC | -3.38 | 52.19 | 0.55 | 759.00 | -0.04 | 0.45 | 0.54 | 126.00 | -0.22 |
| BCH | 53.86 | 102.39 | 0.23 | 117 | 0.58 | 0.68 | 0.45 | 20 | 3.50 |
| ETH | 20.75 | 59.60 | 0.45 | 325.00 | 0.21 | 0.64 | 0.50 | 54.00 | 1.25 |
| XRP | -25.52 | 95.02 | 0.31 | 408.00 | -0.24 | 0.57 | 0.44 | 68.00 | -1.43 |

The results show an investor using the MA would not be trading 55%, 23%, 45% and 31% of the time for *BTC*, *BCH*, *ETH* and *XRP* respectively. When trading, if a buy signal was generated, a positive return was accrued 45% of the time for *BTC*, 68% for *BCH*, 64% for *ETH* and 57% for *XRP*. For each buy signal, the return was in excess of the risk-free rate 54%, 45%, 50% and 44% of the time for *BTC*, *BCH*, *ETH* and *XRP* respectively.

Given the excess return of the MA relative to the BH was statistically insignificant, the adjusted *BETC*6* is not informative, and no conclusions can be drawn from its result.

Overall, the aforementioned values show the MA has difficulty predicting future price movements accurately, or at the very least, provides a signal too late to profit from market movements. However, the risk-reducing benefits in providing a more efficient risk-return profile is still considerable when utilising the MA.

## 4.4 Results - Volatility Indices

The following section reports and analyses the results for volatility indices. Section 4.4.1 contains the summary statistics and regression results. Section 4.4.2 contains the market timing results and trading statistics.

### 4.4.1 Summary Statistics & Regression Analysis

The following section contains the summary statistics in Table 77 and regression results in Table 78 for the three primary US volatility indices *VIX*, *VXO* and *VXN*.

The summary statistics in Table 77 show the MA contributes to a huge drop in mean return performance, with negative performance in the high double digits for all indices. Additionally, the regression results in Table 78 report statistically significant excess return performance for the MA relative to the BH of -87.794% for *VIX*, -94.870% for *VXO* and -54.043% for *VXN* per annum.

These two findings appear to reflect the MA is picking up on the effect the relationship between volatility indices value changes have on overall market performance. Recall, volatility indices are based on 30-day implied volatility on market index options. The market value reported for these indices are inversely related to future market performance. In general, it is expected the higher (lower) the value of the volatility index, the higher (lower) the volatility in the market. This higher (lower) volatility in the market equates to lower (higher) expected returns.

**Table 77: Summary Statistics for Volatility Indices**

Cryptocurrency assets where $\mu$ is the mean return, $\sigma$ is the standard deviation of returns, $s$ is skewness, $k$ is kurtosis and $SR$ is the Sharpe Ratio.

| | BH Portfolio | | | | | MA Portfolio | | | | | TIS Portfolio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* | $\mu$ | $\sigma$ | *s* | *k* | *SR* |
| VIX | 0.72 | 102.79 | 0.90 | 9.76 | -0.02 | -65.99 | 59.86 | 1.20 | 42.19 | -1.15 | -66.70 | 66.83 | -1.32 | 10.30 | -1.00 |
| VXO | 0.80 | 113.17 | 1.52 | 27.64 | -0.02 | -71.63 | 68.31 | 4.42 | 173.99 | -1.09 | -72.43 | 72.77 | -1.28 | 10.42 | -1.00 |
| VXN | -3.91 | 91.97 | 0.77 | 7.55 | -0.06 | -40.57 | 49.71 | 0.94 | 30.22 | -0.84 | -36.66 | 59.64 | -1.09 | 8.35 | -0.61 |

**Table 78: Factor Regression Results for Volatility Indices**

Results for the $TIS_{it}$ excess returns $[0, 0, 0]$ corresponding to [f, d, h] where $f$ is the fixed percentage difference, $d$ is the fixed number of days crossed and $h$ is the minimum number of days held.

| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_s$ | $\beta_h$ | $\beta_u$ | $R^2$ |
|---|---|---|---|---|---|---|
| VIX | -87.794*** | 2.184*** | 0.365*** | 0.221*** | 0.374*** | 0.310 |
| VXO | -94.870*** | 2.335*** | 0.365*** | 0.295*** | 0.325*** | 0.300 |
| VXN | -54.043*** | 1.693*** | 0.858*** | -0.118 | 0.352*** | 0.292 |

Consequently, the summary statistics and regression results stated above show the MA seems to pick up on this relationship, reversing the signal the MA would recommend to the investor. Normally, when the current asset price rises above the MA it signals an investor should buy and visa-versa. However, given the relationship between the volatility indices and market returns, it would appear a buy (sell) signal should actually be the opposite.

In regard to the risk reducing benefits of the MA, the reported results are the opposite of expected. The *SR* decreases by a factor of 57.5 for *VIX*, 54.5 for *VXO* and 14 for *VXN*. While the *SR* decreases, this is due to the large decline in mean performance. However, as discussed previously, the MA appears to be identifying the volatility index inverse relationship with performance. Thus, were a trader to reverse all buys to sells and sells to buys, the *SR* would be an increase rather than a decrease. This can also be seen by reviewing the considerable risk reduction via the standard deviation.

### 4.4.2 Market Timing & Trading Statistics

The following section contains the market timing results in Table 79 and trading statistics in Table 80 for the three primary US volatility indices *VIX*, *VXO* and *VXN*.

As stated in Section 1.6, $\gamma_{i,m}$ and $\beta_{i,m^2}$ must be positive values in order to show market timing for the MA strategy. Table 79 details the market timing results for all three volatility indices with all except *VXO* for the Treynor-Mazuy method reporting statistically significant results except none are positive. The implication here is market timing is not occurring. However, given the findings in Section 4.4.1 this result is logical given market timing would not be found as for every buy signal an investor would be buying into higher risk and for every sell signal, selling out of lower risk. As stated in Section 4.4.1, the MA appears to be

capturing the contrary relationship of volatility indices and market performance, which implies an investor should reverse the rules for the MA strategy.

The trading statistics in Table 80 show while the mean return declines, the risk reducing benefits of the MA against the BH are substantial with the standard deviation reducing per annum by 42.93% for *VIX*, 44.86% for *VXO* and 37.22% for *VXN*.

The table also shows the MA strategy requires an investor to trade quite frequently, with days not trading at only 32%, 31% and 31% for *VIX*, *VXO* and *VXN* respectively. When trading on a buy signal, the MA achieved a positive return 66% of the time for *VIX*, 68% for *VXO* and 57% for *VXN*. Of those buy signals that achieve positive returns, a return in excess of the risk-free rate occurs 47%, 48% and 46% of the time for *VIX*, *VXO* and *VXN* respectively.

These findings are interesting as it shows the MA is correctly identifying trends, but given the statistically significant negative returns, is too late to capture the trend and thus the reverse effect as mentioned previously occurs. Effectively, as the volatility index value rises above the MA the volatility forecast is higher and thus the MA strategy is actually likely to return a negative result were an investor buy in.

Given the excess return of the MA was negative the adjusted *BETC*6* is not informative, and no conclusions can be drawn from its result. Understandably, were an investor to trade the MA as normal, they would achieve significantly lower returns than the BH after cost.

Overall, the aforementioned results and analysis show a potentially interesting effect the MA captures when used on volatility indices. The MA in this case appears to have the ability to predict what an investor should not do, rather than what to do.

**Table 79: Market Timing Results for Volatility Indices**

| | Treynor-Mazuy | | | | Henriksson-Merton | | | |
|---|---|---|---|---|---|---|---|---|
| *Portfolio* | $\alpha$ | $\beta_m$ | $\beta_m{}^2$ | $R^2$ | $\alpha$ | $\beta_m$ | $\gamma_m$ | $R^2$ |
| VIX | -62.202*** | 2.108*** | -0.071*** | 0.307 | 8.346 | 1.605*** | -0.992*** | 0.312 |
| VXO | -93.979*** | 2.270*** | 0.009 | 0.295 | -9.339 | 1.790*** | -0.893*** | 0.301 |
| VXN | -33.076*** | 1.613*** | -0.048*** | 0.267 | 16.784 | 1.269*** | -0.673*** | 0.270 |

**Table 80: Summary Trading Statistics for Volatility Indices**

| *Portfolio* | $\Delta\mu$ | $\Delta\sigma$ | *pA* | *NT* | *BETC* | *p1* | *p2* | *NT/6* | *BETC*6* |
|---|---|---|---|---|---|---|---|---|---|
| VIX | -66.70 | 42.93 | 0.32 | 3661 | -0.53 | 0.66 | 0.47 | 610 | -3.18 |
| VXO | -72.43 | 44.86 | 0.31 | 4166 | -0.58 | 0.68 | 0.48 | 694 | -3.45 |
| VXN | -39.19 | 37.22 | 0.31 | 2110 | -0.33 | 0.57 | 0.46 | 352 | -1.99 |

## 4.5 Conclusion

The results in Section 4 are not as robust as those seen in Section 2 and 3. The major finding is the continued evidence of the risk reducing benefits of the MA. Irrespective of excess return performance, the MA is able to consistently reduce the standard deviation of returns for cryptocurrencies and volatility indices.

As was the case in Section 2 and 3 subperiod analysis was conducted for the cryptocurrencies and volatility indices. However, it was not included as it does not alter the results and conclusions in any meaningful way, unlike in Section 2 and 3.

Section 4.3 reported and analysed the MA performance for cryptocurrencies. The results do not appear to support nor refute the findings in previous sections relating to the MA and its excess return potential. The report details a complete lack of statistically significant alphas. As a result, it is not possible to conclude either way whether on the MA and its predictive power. However, given how little the price movements and subsequent returns of cryptocurrencies correlate to risk compensation fundamentals, it appears the results above are evidence of an asset class based purely on speculative pricing. Thus, it can be argued cryptocurrency is a true random walk asset. This could potentially explain the lack of results for the MA over the BH.

Additionally, the findings do not support nor refute the conclusions of Detzel et al. (2021) regarding statistically significant MA excess returns. However, the risk reducing benefits of the MA and its ability to improve the *SR* are congruent with their findings. The MA predictive power ensures extreme market movements are dampened in both directions. For assets with extreme volatility, such as cryptocurrencies, this has value added potential for investors.

Section 4.4 reported and analysed the MA performance for volatility indices. The excess return performance for the MA was statistically significant and negative. Under normal circumstances this would indicate the MA has been unsuccessful in predicting future price movements. However, consider how a volatility index derives its value. When volatility is rising above the MA, it indicates 30-day future performance will negatively affect investor returns; when volatility is declining below the MA, it indicates 30-day future performance will positively affect performance. The findings and implications are quite fascinating given it provides an inherent logic to the MA statistically significant negative returns. When the MA is telling you the volatility index is rising, an investor should sell, not buy. When the volatility index is falling, buy, not sell. This is the exact opposite of the MA rule for all other asset types.

Furthermore, the excess return results highlight how for volatility indices, high market volatility is very quickly followed by a significant drop in market volatility far below the MA "buy signal price", hence the large negative statistically significant alphas. Taking advantage of this inverse relationship has the potential to be explored in future research.

The risk-reducing benefits continue to be of significant benefit to any investor utilising the MA over the BH, with large drops in the standard deviation of returns for volatility indices. Given this was also found to be the case for cryptocurrencies, the results show even for assets with such extreme market volatility, the MA has a huge positive effect on the standard deviation of returns over the investment time horizon.

# 5.0 The Moving Average and Delaying Effects

## 5.1 Introduction

The Moving Average (MA) strategy and its ability to generate excess returns over the BH strategy has been discussed in detail in Section 1, 2, 3 and 4. However, one issue with many Technical Indicators including the MA is the timing of trades. To ensure data-snooping does not occur, the MA is calculated using at-close market prices, with the trade from the signal occurring the following day at open. The issue here is investors are not guaranteed the close price will remain constant at open. Thus, it creates a potential return estimation error, positive and negative, for each trade. Additionally, not all investors have access to the same level of trading information and abilities. This could potentially lead to delays in implementing the buy/sell signal.

To address the aforementioned issues, the MA methodology described in Section 1.5 was adapted to incorporate various lag effects on the trading signal. As previously stated in Section 1.5, the lag effects are as follows:

A trading signal is only generated when the $P_{it}$ and $MA_{it,L}$ differ by a fixed percentage $f$.
A trading signal is only generated when the $P_{it}$and $MA_{it,L}$ differ for a fixed number of days $d$.
All changes in position, buy-in or sell-out, are held for a minimum number of days $h$.

Each of these variables are referred to as [$f$, $d$, $h$] and are set ex-ante with altered MA returns calculated ex-post.

The research in Section 5 analyses the MA performance changes associated with [$f$, $d$, $h$] using the Developed Market Indices from Section 2 and the US Industry Indices from Section 3.

## 5.2 The $[f, d, h]$ Data

The data used in this section is the same as used in Section 2 and Section 3, with both Developed Market Indices and US Industry Indices analysed.

Please refer to Section 2.2, Table 1 for a detailed breakdown of the Developed Market Indices and their country composition. As in Section 2, the data was sourced from the Kenneth R. French Data Library encompassing a time horizon from January 1, 1991 to October 31, 2018 with daily returns used.

The analysis contained in Section 5.3 reviews the findings of all 6 country indices for the quintiles corresponding to the size category *Small*. However, due to the sheer number of tables and figures, Section 5.3 will only report the results for the value and equal weighted Developed Index corresponding to Quintile *S-Low*. The remaining indices for size category *Small* can be found in Appendix 1-232. Discussion in Section 5.3 will refer to the appendices in general as supportive evidence. Subperiods are also not included as it does not add anything to the analysis.

Please refer to Section 3.2, Table 62 for a list of Industry Indices used and their abbreviations. As in Section 3, the data was sourced from the Kenneth R. French Data Library incorporating a time horizon from July 1, 1969 to October 31, 2018 with daily returns used.

The analysis contained in Section 5.4 reviews the top three performing value and equal weighted indices sorted by statistically significant alpha from Section 4. The top three value weighted indices are *RlEst*, *Hlth* and *Txtls.* The top three equal weighted indices are *Hardw*, *Softw* and *Chips.* The results for value and equal weights are reported for both top three indices. Given the number of tables and figures, only the results for value and equal weighted

*RlEst* are reported in Section 5.4. The remaining indices data can be found in Appendix 233-272. As with the Developed Market indices, subperiods are not included.

In regard to the assigned values for [*f*, *d, h*], the fixed percentage *f* can take the value 0%, 0.5%, 1% and 1.5%. This corresponds to increments of 50 basis points, which is the maximum cost per trade (Balduzzi & Lynch 1999). The fixed number of days *d* can take the value 0, 1, 2, 3, 4 and 5 and the fixed number of days held *h* can take the value 0, 1, 2, 3, 4 and 5. Both *d* and *h* values represent up to one trading week of delays.

The summary statistics, regression results, marking timing results and trading statistics were all collated for each [*f*, *d, h*] combination across all indices and quintiles. However, only the pertinent information is displayed in Section 5.2 as reporting it in its entirety would require displaying a total of 229,248 tables which accounts for all indices and quintiles for both value and equal weightings. If the reader is interested in reviewing the entirety of the data, the author can provide all the results on request.

Overall, the analysis will review 144 possible combinations of [*f*, *d, h*] for each index and relevant quintile.

## 5.3 Developed Market Indices and [*f*, *d*, *h*]

The following section reports the effect adjusting the [*f*, *d*, *h*] variables have on MA performance relative to the BH for the Developed Market indices.

The results for the value and equal weighted Developed index quintile *S-Low* are contained in the subsequent tables and figures, with the remaining indices for size category *Small* found in Appendix 1-232.

Figure 11, value weighted, and Figure 14, equal weighted, show graphically the abnormal returns for a constant *f* as *d* and *h* increase from 0 to 5. Figure 12, value weighted, and Figure 15, equal weighted, show graphically the abnormal returns for a constant *d* as *f* increases from 0% to 1.5% and *h* increases from 0 to 5. Figure 13, value weighted, and Figure 16, equal weighted, show graphically the abnormal returns for a constant *h* as *f* increases from 0% to 1.5% and *d* increases from 0 to 5. Table 81, value weighted, and Table 82, equal weighted, shows all the alphas for all combinations of [*f*, *d*, *h*] with significance tests at the 90%, 95% and 99% confidence level are used, corresponding to *, ** and *** respectively.

Reviewing the aforementioned tables and figures including the appendices, a pattern emerges for [*f*, *d*, *h*] value changes. The performance of the MA abnormal return in almost all cases declines as [*f*, *d*, *h*] increases from [*0*, *0*, *0*] to [*1.5*, *5*, *5*]. However, the performance differential is not as diminished as expected, given positive statistically significant results are still maintained in almost all scenarios. Only the most extreme scenarios cause a lack of statistical significance, generally due to a lack of performance in the base case [*0*, *0*, *0*]. An example of this is North America quintile *S-High* in Appendix 212.

**Figure 11: VW Developed S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.

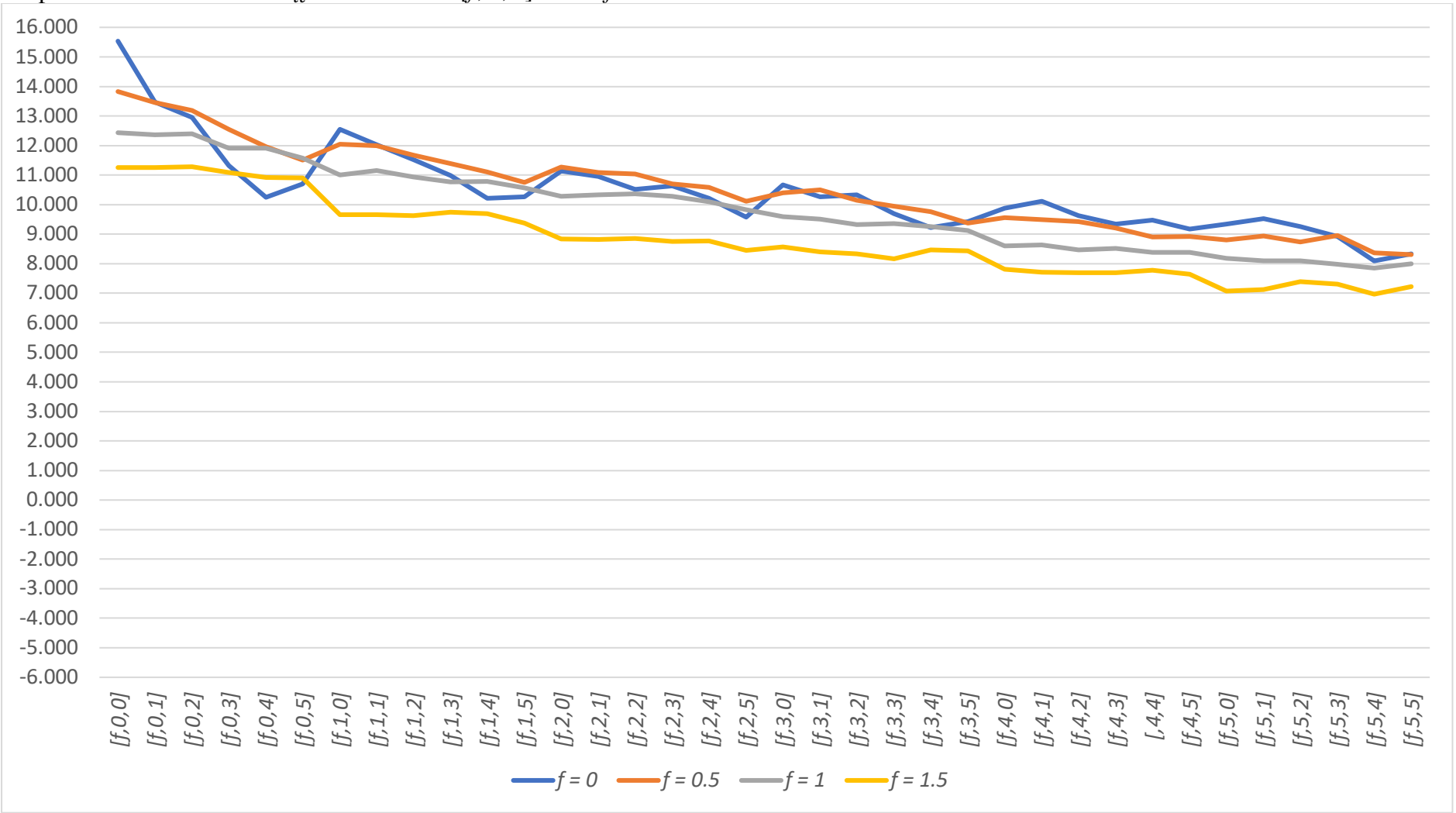


**Figure 12: VW Developed S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.

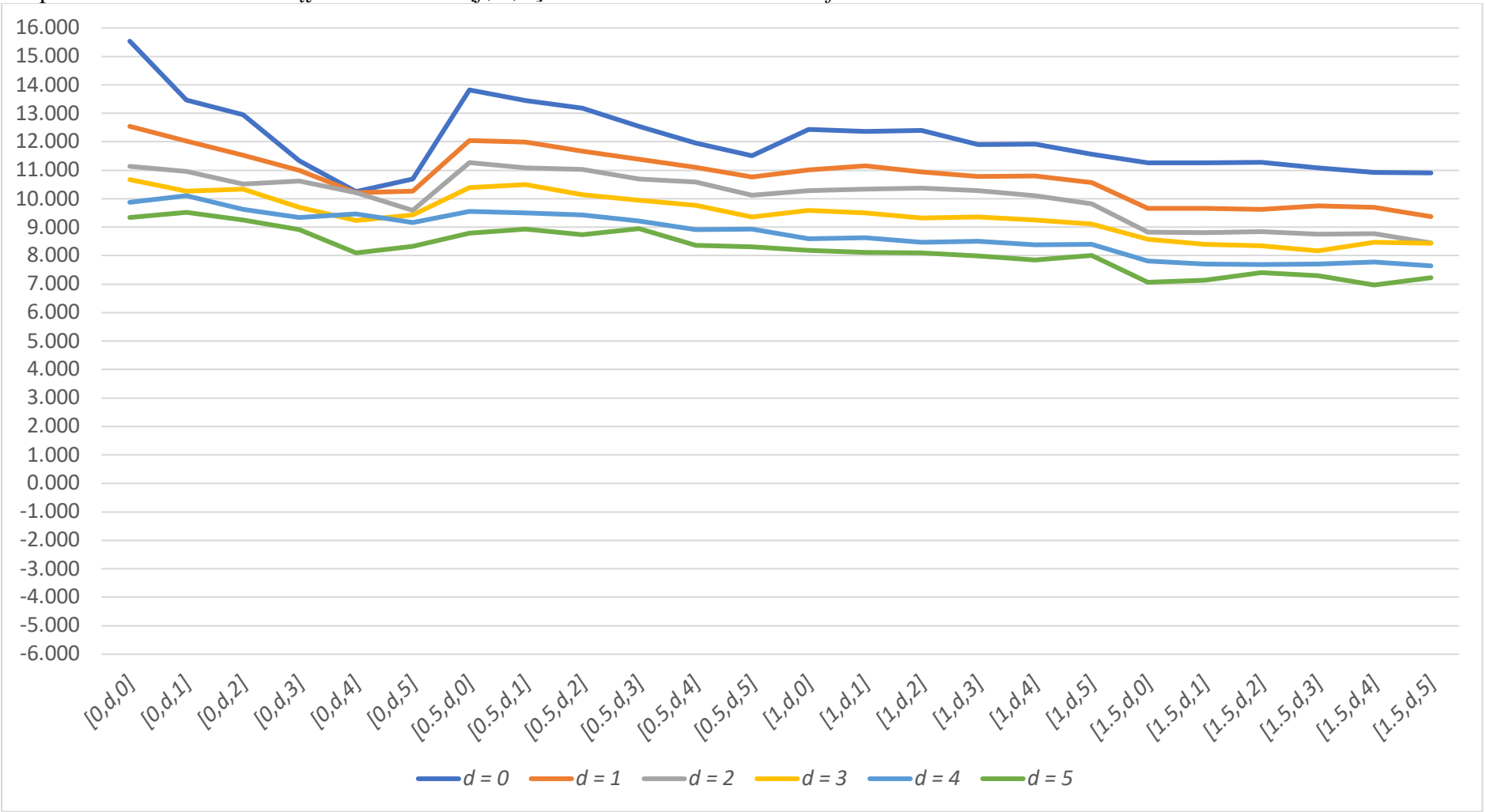


**Figure 13: VW Developed S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.

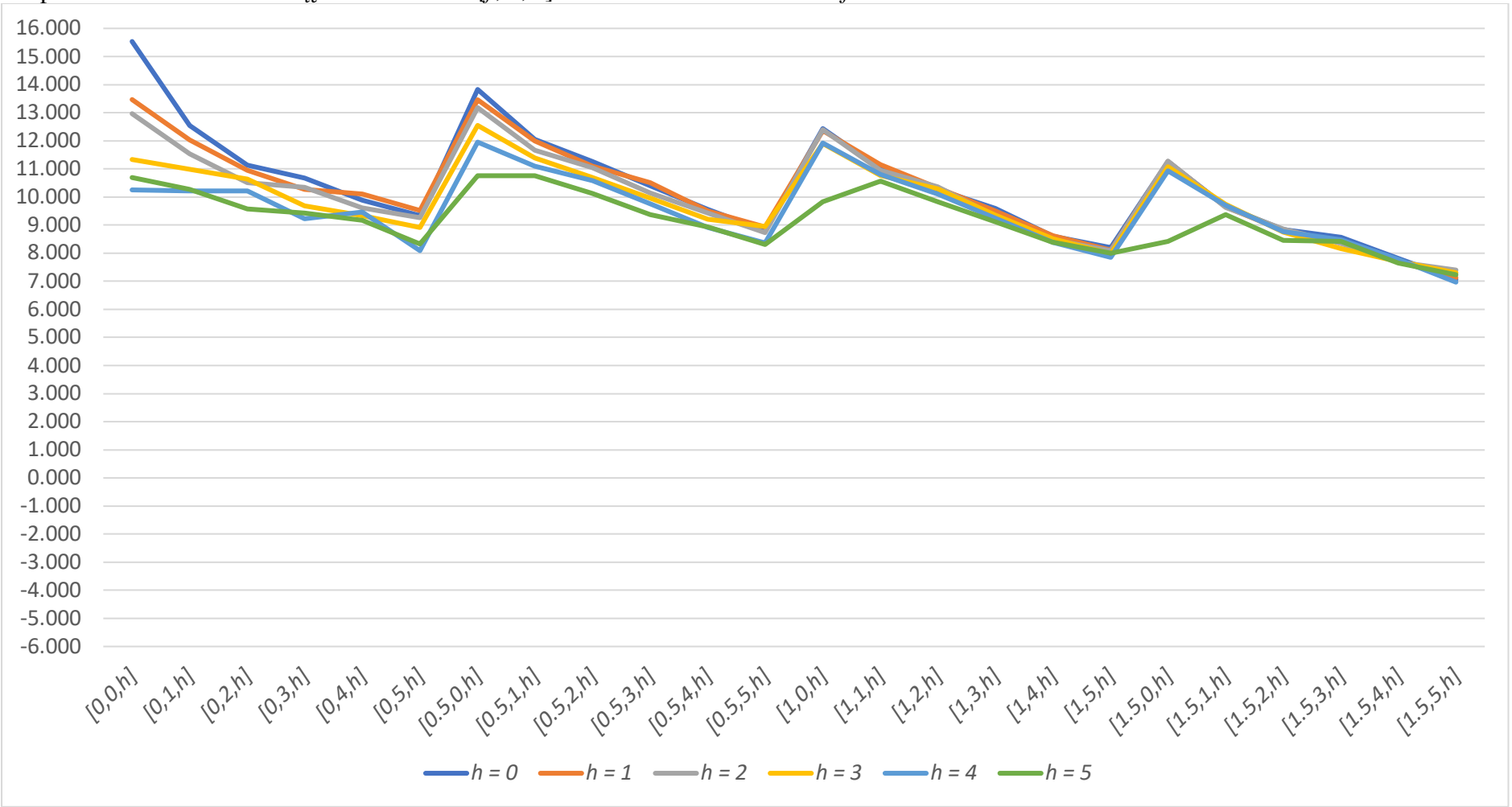


**Table 81: VW Developed S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 15.534*** | 13.467*** | 12.956*** | 11.327*** | 10.250*** | 10.693*** |
| 1 | 12.542*** | 12.022*** | 11.527*** | 10.994*** | 10.206*** | 10.262*** |
| 2 | 11.140*** | 10.952*** | 10.514*** | 10.629*** | 10.207*** | 9.582*** |
| 3 | 10.671*** | 10.271*** | 10.337*** | 9.688*** | 9.230*** | 9.423*** |
| 4 | 9.881*** | 10.105*** | 9.618*** | 9.343*** | 9.467*** | 9.169*** |
| 5 | 9.339*** | 9.520*** | 9.259*** | 8.921*** | 8.094*** | 8.332*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.827*** | 13.453*** | 13.180*** | 12.547*** | 11.953*** | 11.511*** |
| 1 | 12.043*** | 11.990*** | 11.667*** | 11.387*** | 11.102*** | 10.756*** |
| 2 | 11.268*** | 11.087*** | 11.035*** | 10.699*** | 10.587*** | 10.121*** |
| 3 | 10.397*** | 10.504*** | 10.140*** | 9.952*** | 9.762*** | 9.367*** |
| 4 | 9.551*** | 9.493*** | 9.432*** | 9.213*** | 8.911*** | 8.928*** |
| 5 | 8.795*** | 8.939*** | 8.734*** | 8.950*** | 8.371*** | 8.308*** |

***f = 1***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.434*** | 12.542*** | 12.022*** | 11.527*** | 10.994*** | 10.206*** |
| 1 | 11.006*** | 11.146*** | 10.943*** | 10.772*** | 10.793*** | 10.564*** |
| 2 | 10.274*** | 10.331*** | 10.363*** | 10.285*** | 10.100*** | 9.829*** |
| 3 | 9.592*** | 9.503*** | 9.322*** | 9.355*** | 9.251*** | 9.116*** |
| 4 | 8.599*** | 8.629*** | 8.467*** | 8.512*** | 8.384*** | 8.390*** |
| 5 | 8.190*** | 8.106*** | 8.096*** | 7.982*** | 7.851*** | 8.000*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.263*** | 12.043*** | 11.990*** | 11.667*** | 11.387*** | 11.102*** |
| 1 | 9.661*** | 9.653*** | 9.621*** | 9.741*** | 9.695*** | 9.371*** |
| 2 | 8.833*** | 8.812*** | 8.850*** | 8.755*** | 8.775*** | 8.447*** |
| 3 | 8.573*** | 8.402*** | 8.338*** | 8.169*** | 8.469*** | 8.427*** |
| 4 | 7.809*** | 7.712*** | 7.690*** | 7.698*** | 7.774*** | 7.641*** |
| 5 | 7.065*** | 7.129*** | 7.399*** | 7.303*** | 6.968*** | 7.232*** |

**Figure 14: EW Developed S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.

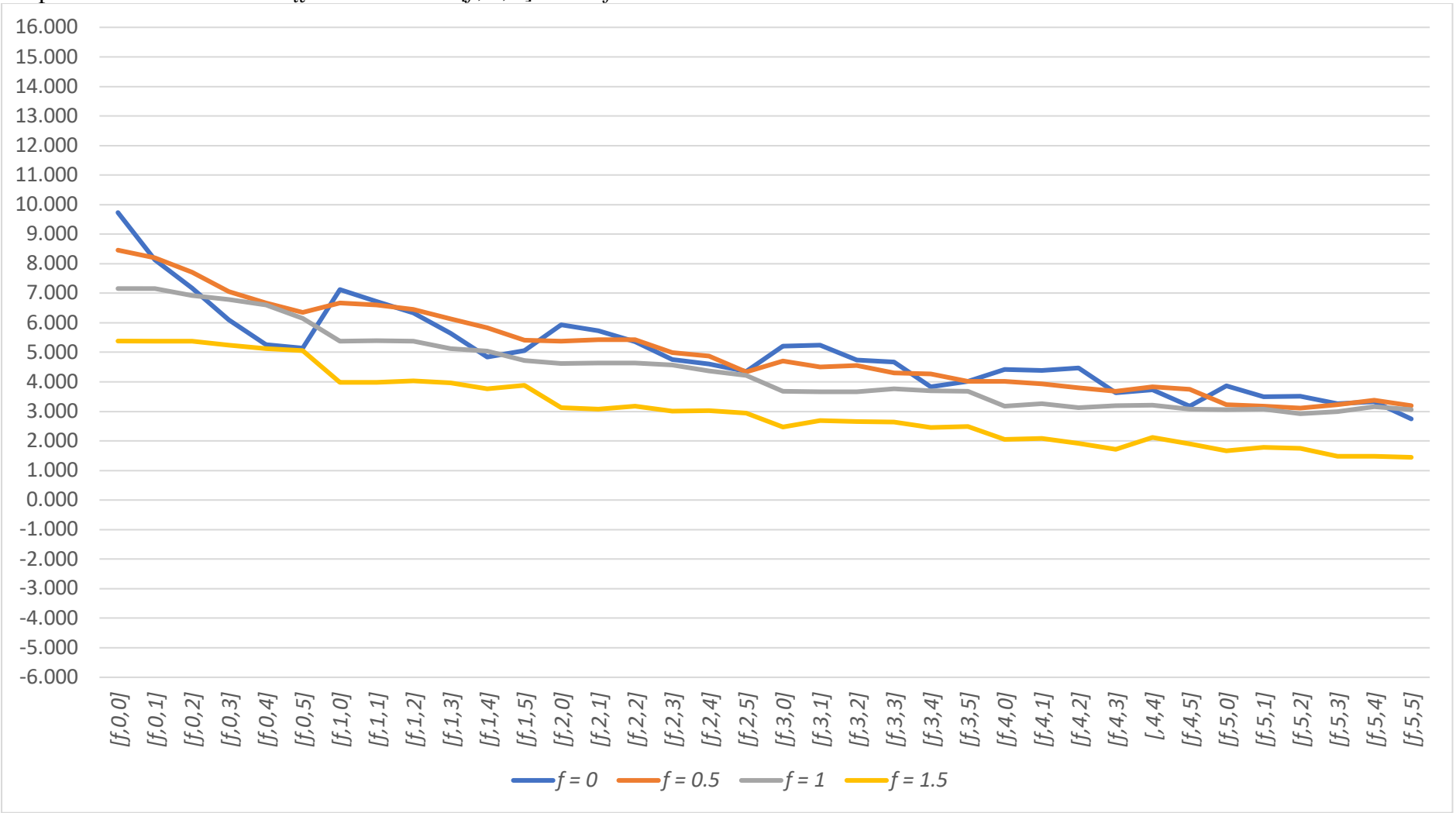


**Figure 15: EW Developed S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.

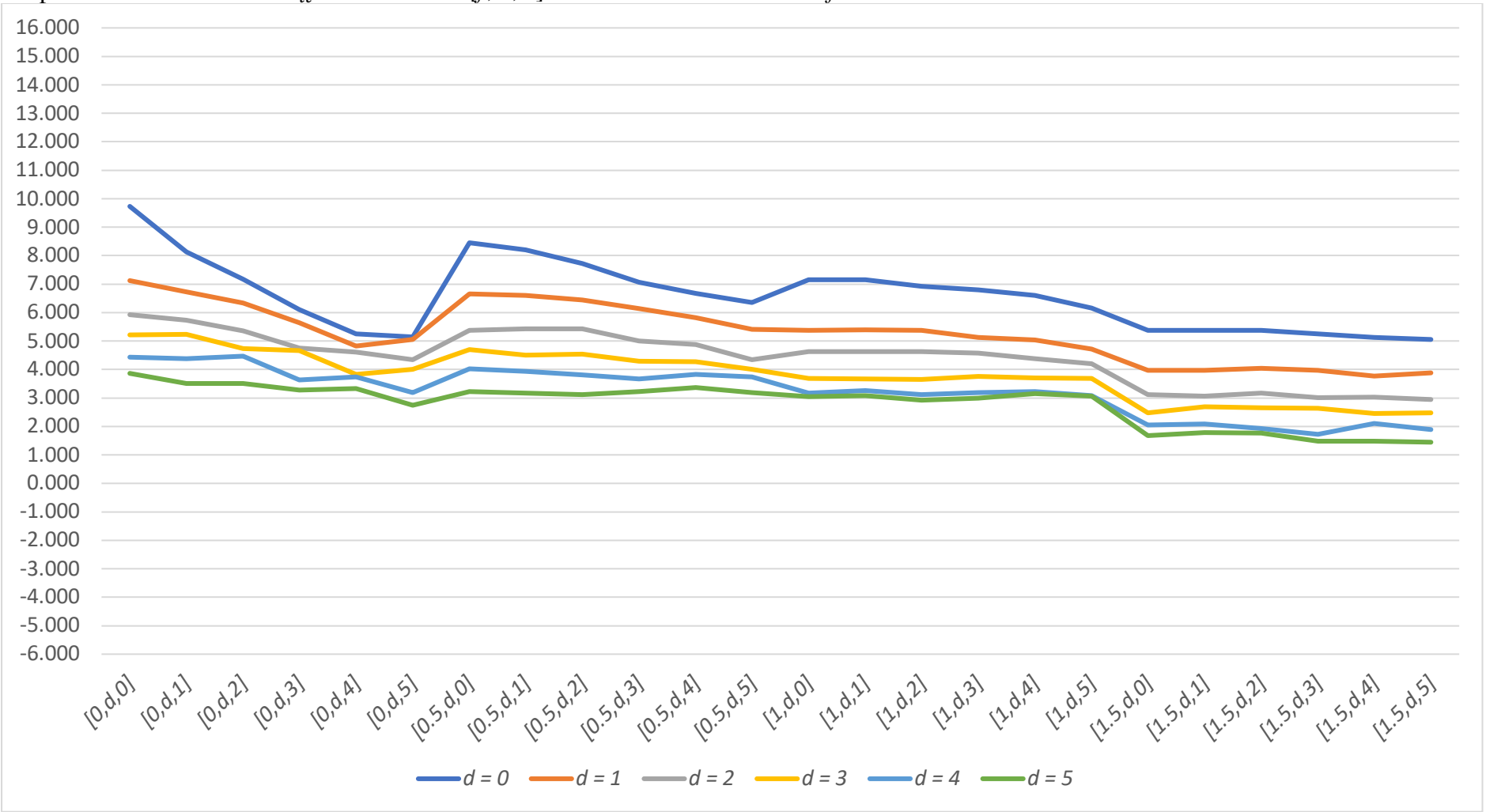


**Figure 16: EW Developed S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.

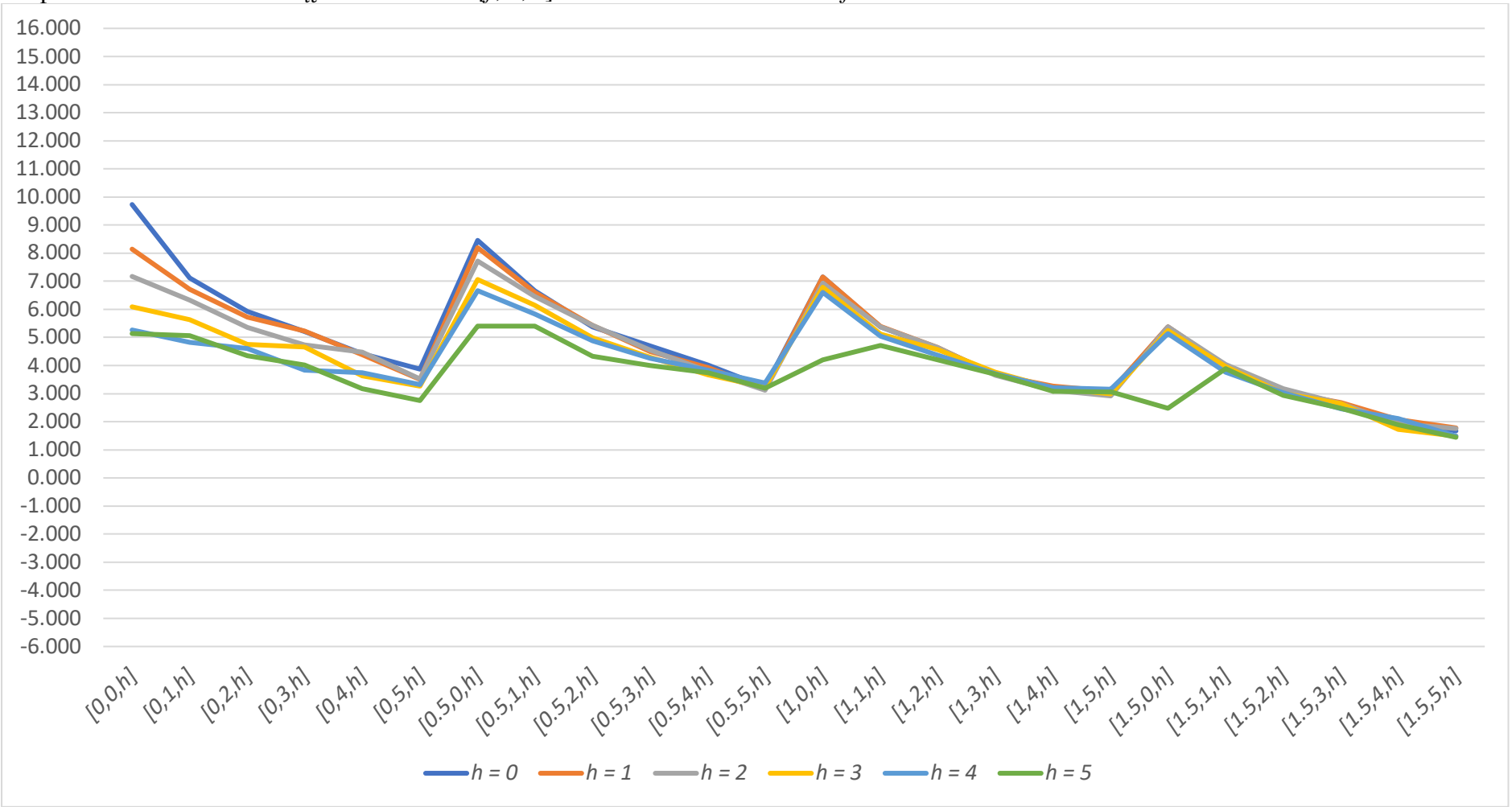


**Table 82: EW Developed S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.731*** | 8.137*** | 7.172*** | 6.098*** | 5.257*** | 5.138*** |
| 1 | 7.122*** | 6.718*** | 6.333*** | 5.639*** | 4.833*** | 5.058*** |
| 2 | 5.925*** | 5.727*** | 5.357*** | 4.758*** | 4.609*** | 4.346*** |
| 3 | 5.207*** | 5.235*** | 4.737*** | 4.664*** | 3.837*** | 4.014*** |
| 4 | 4.428*** | 4.387*** | 4.469*** | 3.638*** | 3.739*** | 3.182*** |
| 5 | 3.864*** | 3.504*** | 3.517*** | 3.269*** | 3.327*** | 2.746** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.458*** | 8.197*** | 7.719*** | 7.062*** | 6.665*** | 6.345*** |
| 1 | 6.663*** | 6.602*** | 6.450*** | 6.140*** | 5.826*** | 5.403*** |
| 2 | 5.370*** | 5.429*** | 5.425*** | 4.999*** | 4.878*** | 4.337*** |
| 3 | 4.703*** | 4.496*** | 4.548*** | 4.295*** | 4.265*** | 4.009*** |
| 4 | 4.020*** | 3.935*** | 3.806*** | 3.677*** | 3.829*** | 3.746*** |
| 5 | 3.229*** | 3.170*** | 3.112*** | 3.227*** | 3.373*** | 3.196*** |

***f = 1***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.158*** | 7.122*** | 6.718*** | 6.333*** | 5.639*** | 4.833*** |
| 1 | 5.376*** | 5.394*** | 5.377*** | 5.126*** | 5.037*** | 4.719*** |
| 2 | 4.626*** | 4.637*** | 4.634*** | 4.571*** | 4.375*** | 4.211*** |
| 3 | 3.685*** | 3.665*** | 3.659*** | 3.762*** | 3.699*** | 3.682*** |
| 4 | 3.169*** | 3.266*** | 3.123*** | 3.195*** | 3.219*** | 3.082*** |
| 5 | 3.052** | 3.081*** | 2.922** | 2.985** | 3.157*** | 3.057*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.382*** | 6.663*** | 6.602*** | 6.450*** | 6.140*** | 5.826*** |
| 1 | 3.978*** | 3.977*** | 4.036*** | 3.963*** | 3.769*** | 3.887*** |
| 2 | 3.125*** | 3.070*** | 3.171*** | 3.002** | 3.022*** | 2.946** |
| 3 | 2.470** | 2.684** | 2.653** | 2.636** | 2.455** | 2.483** |
| 4 | 2.052* | 2.083* | 1.920 | 1.723 | 2.113* | 1.896 |
| 5 | 1.673 | 1.780 | 1.758 | 1.488 | 1.489 | 1.446 |

When reviewing [$f$, $d$, $h$] using ceteris paribus, it appears the variable causing the highest degree of performance change is $d$, whereby the trading signal is only generated when the $P_{it}$and $MA_{it,L}$ differ for a fixed number of days $d$. This result indicates the importance of buying into or selling out of the asset when the MA signal occurs is high. Delaying entry or exit from the stock causes the largest performance differential for an investor.

The second highest cause of performance differential is $h$, whereby a new position from buying or selling is held for a minimum number of days $h$. This has a similar effect to $d$, as an investor may miss signals occurring during the holding period. This result implies an investor needs to keep up to date with their portfolio and market movements. Missing signals can adversely alter performance.

It is interesting to note, given variable $d$ has a larger effect on performance than $h$, it is evidence that the MA signal does more often than not indicate a future performance trend. Missing this trend, whether through a buy-in or a sell-out, has a greater effect on performance than waiting after a position is changed.

Finally, the variable with the least effect on performance is $f$. Even when using a fixed percentage as large as three times the 50-basis point average transaction cost, an investor is still able to achieve a considerable positive statistically significant MA excess return.

To simplify the performance interactions in the tables and figures above refer to the percentage changes found in Table 83 and 84.

**Table 83: VW Developed S-Low [*f*, *d*, *h*] Interactions**

| | ***f*** | | | |
|---|---|---|---|---|
| | **0** | **0.5** | **1** | **1.5** |
| ***max Δh, d = 0*** | -31.16% | -16.75% | -17.92% | -1.43% |
| ***max Δd, h = 0*** | -39.88% | -36.39% | -34.13% | -37.27% |
| ***max Δh & Δd*** | -46.36% | -39.91% | -35.66% | -35.79% |

**Table 84: EW Developed S-Low [*f*, *d*, *h*] Interactions**

| | *f* 0 | 0.5 | 1 | 1.5 |
|---|---|---|---|---|
| ***max Δh, d = 0*** | -47.20% | -24.98% | -32.48% | 8.25% |
| ***max Δd, h = 0*** | -60.29% | -61.82% | -57.36% | -68.91% |
| ***max Δh & max Δd*** | -71.78% | -62.21% | -57.29% | -73.13% |

The results reported in Table 83 and 84 represent the percentage performance change for the abnormal return. The row "*max Δdh, d = 0"* denotes the maximum percentage change when *h* equals 0 and 5, *d* is 0, for each value of *f*. The row "*max Δd, h = 0"* denotes the maximum percentage change when *d* equals 0 and 5, *h* is 0, for each value of *f*. The row "*max Δh & max Δd"* denotes the maximum percentage change when *h* and *d* equal 0 and 5, for each value of *f*.

Overall, the results show an investor is always going to be better off trading as soon as an MA signal occurs. Second guessing the signal will only reduce performance across the investment time horizon.

However, the performance differential for changes in [*f*, *d*, *h*] appears to diminish and flatten when the base case [*0*, *0, 0*] abnormal return is lower. This is evident when comparing the tables and figures for quintiles *S-Low* against quintiles *S-High* in the appendices. Additionally, while not shown in the appendices, for larger sized quintiles without statistically significant alphas, surprisingly, the performance does not reduce significantly even when utilising the worst-case scenario [*1.5*, *5, 5*]. This is continued evidence of the risk reducing benefits of the MA. Even delaying trading does not considerably negatively alter the portfolio return. While an investor may not achieve returns in excess of the BH after cost, the risk is reduced in all scenarios.

Finally, it should also be noted the adjusted *BETC*6* is above 50 basis points for only the smallest quintile for size and book-to-market *S-Low* even for the worst-case scenario [*1.5*, *5*, *5*] across all the indices. Interestingly though, in some cases the adjusted *BETC*6* actually improves as [*f*, *d*, *h*] increases due to trading less, a direct result of waiting before and holding after a buy/sell.

## 5.4 US Industry Indices and [*f*, *d*, *h*]

The following section reports the effect alteration to the [*f*, *d*, *h*] variables have on MA performance relative to the BH for the US Industry indices.

The results for the value and equal weighted *RlEst* index are contained in the subsequent tables and figures, with the remaining indices *Hlth*, *Txtls*, *Hardw, Softw* and *Chips* found in Appendix 233-272.

Figure 17, value weighted, and Figure 20, equal weighted, show graphically the abnormal returns for a constant *f* as *d* and *h* increase from 0 to 5. Figure 18, value weighted, and Figure 21, equal weighted, show graphically the abnormal returns for a constant *d* as *f* increases from 0% to 1.5% and *h* increases from 0 to 5. Figure 19, value weighted, and Figure 22, equal weighted, show graphically the abnormal returns for a constant *h* as *f* increases from 0% to 1.5% and *d* increases from 0 to 5. Table 85, value weighted, and Table 86, equal weighted, shows all the alphas for all combinations of [*f*, *d*, *h*] with significance tests at the 90%, 95% and 99% confidence level are used, corresponding to *, ** and *** respectively.

The results in the tables and figures below and the appendices relating to the US Industry top three indices show contrasting results when comparing the value and equal weighted results. The top three value weighted indices *RlEst*, *Hlth* and *Txtls* maintain statistically significant results even for their equal weighted counterparts. This however is not the case for the top three equal weighted indices *Hardw, Softw* and *Chips* with all three reporting almost zero statistically significant results for value weighted.

Irrespective of the above, when reviewing the statistically significant results the same patterns discussed in Section 5.3 occur.

**Figure 17: VW Real Estate [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.

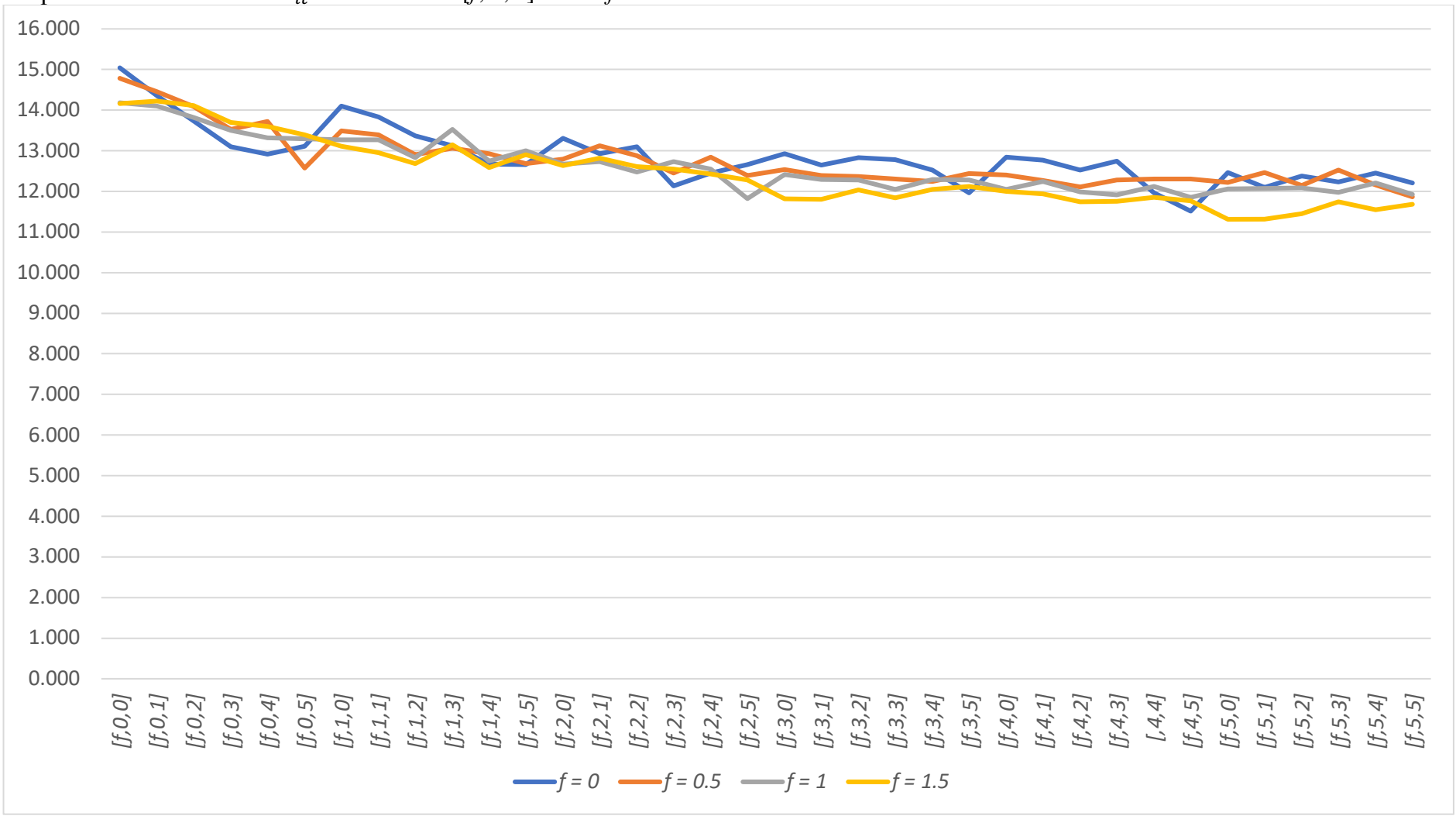


**Figure 18: VW Real Estate [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.

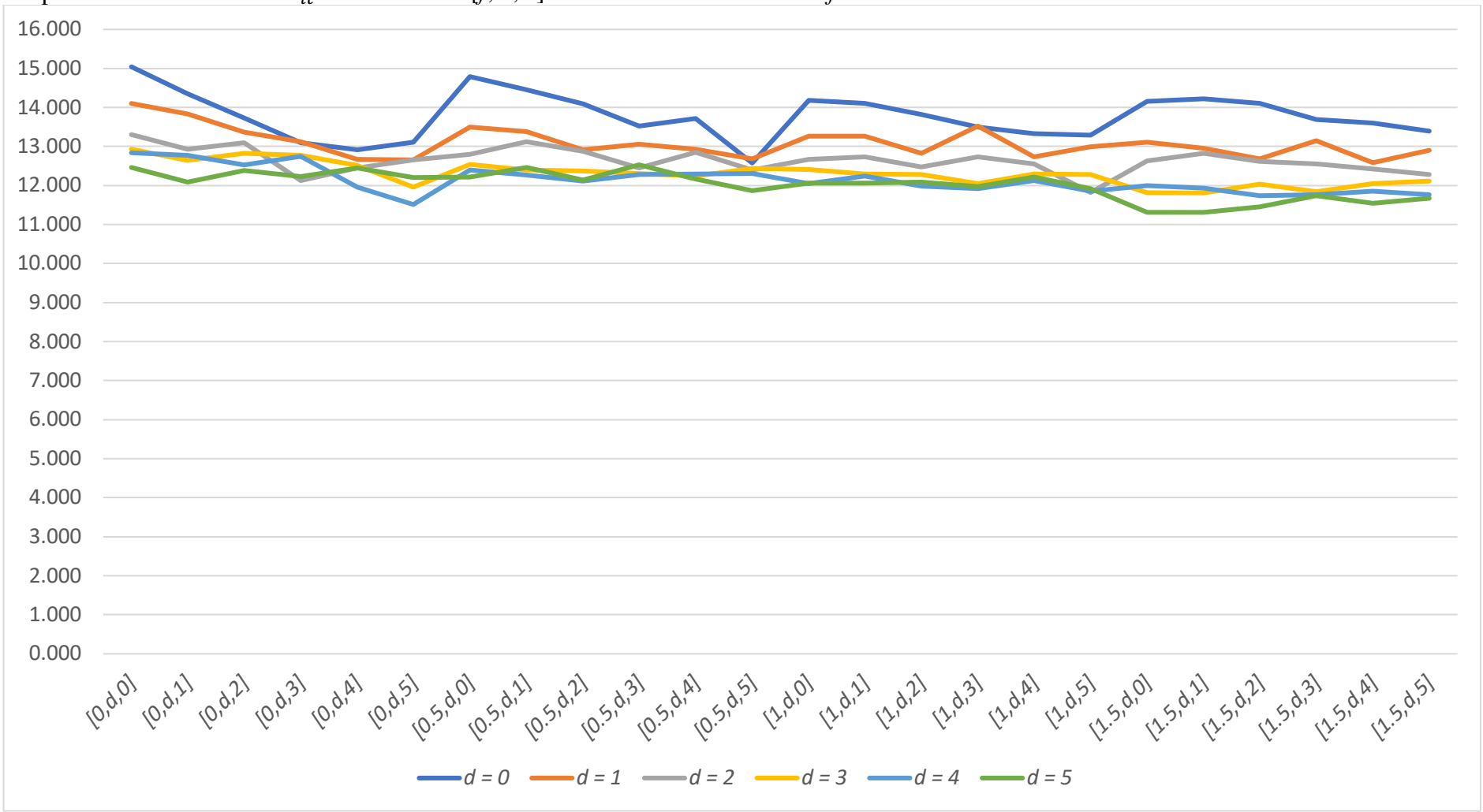


**Figure 19: VW Real Estate [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.

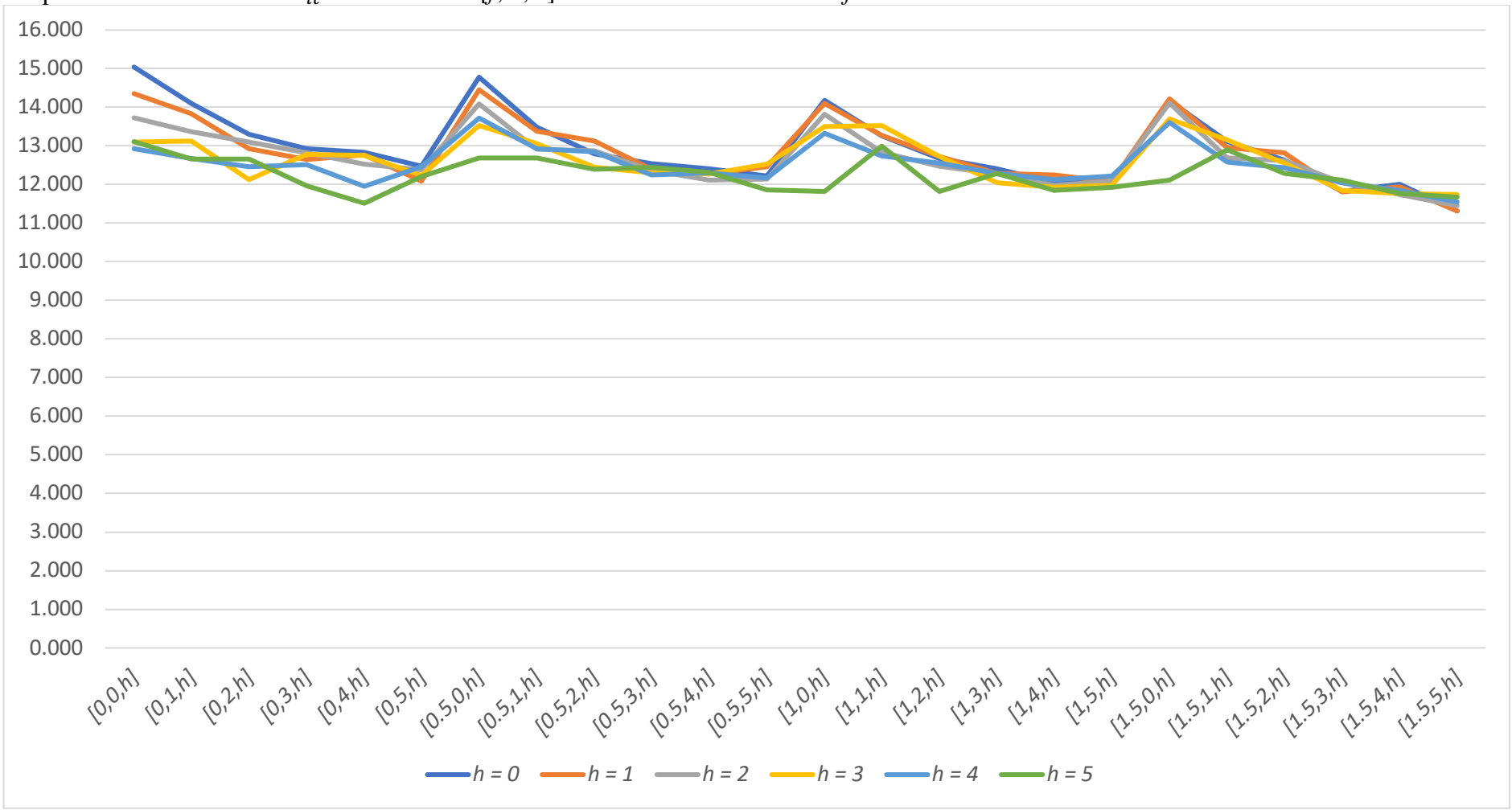


**Table 85: VW Real Estate [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 15.042*** | 14.351*** | 13.729*** | 13.102*** | 12.921*** | 13.110*** |
| 1 | 14.102*** | 13.829*** | 13.362*** | 13.124*** | 12.667*** | 12.661*** |
| 2 | 13.304*** | 12.930*** | 13.097*** | 12.130*** | 12.455*** | 12.655*** |
| 3 | 12.931*** | 12.647*** | 12.825*** | 12.776*** | 12.519*** | 11.964*** |
| 4 | 12.839*** | 12.768*** | 12.526*** | 12.750*** | 11.959*** | 11.513*** |
| 5 | 12.469*** | 12.092*** | 12.379*** | 12.233*** | 12.455*** | 12.207*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.784*** | 14.452*** | 14.091*** | 13.520*** | 13.720*** | 12.576*** |
| 1 | 13.491*** | 13.386*** | 12.909*** | 13.058*** | 12.926*** | 12.680*** |
| 2 | 12.798*** | 13.122*** | 12.874*** | 12.449*** | 12.847*** | 12.392*** |
| 3 | 12.541*** | 12.392*** | 12.368*** | 12.302*** | 12.244*** | 12.443*** |
| 4 | 12.404*** | 12.268*** | 12.112*** | 12.278*** | 12.299*** | 12.310*** |
| 5 | 12.220*** | 12.465*** | 12.142*** | 12.530*** | 12.161*** | 11.865*** |

***f = 1***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.182*** | 14.102*** | 13.829*** | 13.362*** | 13.124*** | 12.667*** |
| 1 | 13.264*** | 13.268*** | 12.829*** | 13.523*** | 12.739*** | 12.998*** |
| 2 | 12.667*** | 12.730*** | 12.475*** | 12.729*** | 12.552*** | 11.821*** |
| 3 | 12.411*** | 12.292*** | 12.278*** | 12.048*** | 12.290*** | 12.281*** |
| 4 | 12.049*** | 12.244*** | 11.982*** | 11.920*** | 12.127*** | 11.849*** |
| 5 | 12.061*** | 12.068*** | 12.089*** | 11.977*** | 12.213*** | 11.925*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.160*** | 13.491*** | 13.386*** | 12.909*** | 13.058*** | 12.926*** |
| 1 | 13.113*** | 12.956*** | 12.683*** | 13.153*** | 12.585*** | 12.905*** |
| 2 | 12.632*** | 12.821*** | 12.615*** | 12.549*** | 12.429*** | 12.286*** |
| 3 | 11.813*** | 11.809*** | 12.041*** | 11.846*** | 12.046*** | 12.118*** |
| 4 | 12.003*** | 11.937*** | 11.737*** | 11.760*** | 11.850*** | 11.763*** |
| 5 | 11.313*** | 11.316*** | 11.449*** | 11.739*** | 11.545*** | 11.678*** |

**Figure 20: EW Real Estate [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.

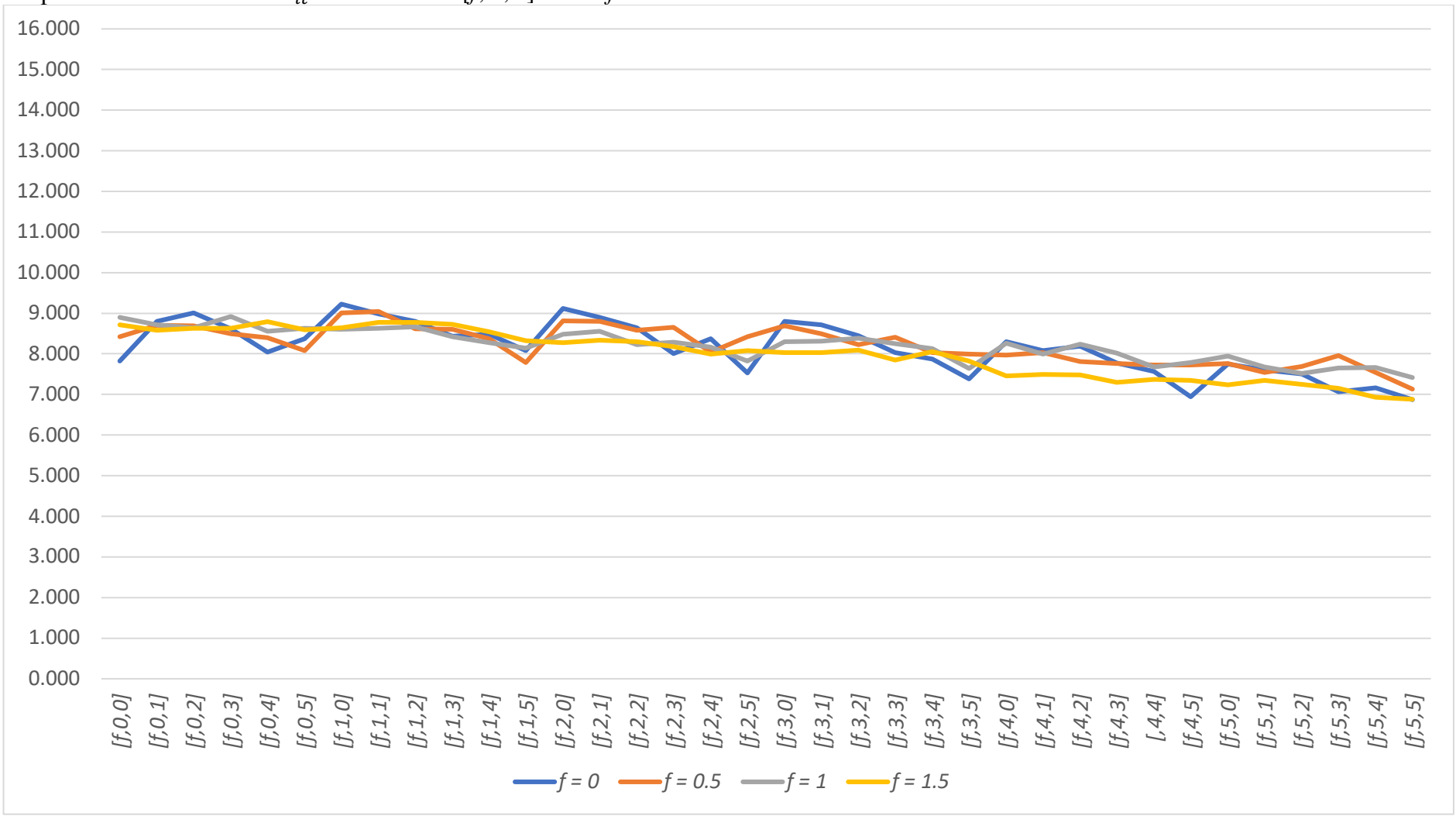


**Figure 21: EW Real Estate [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.

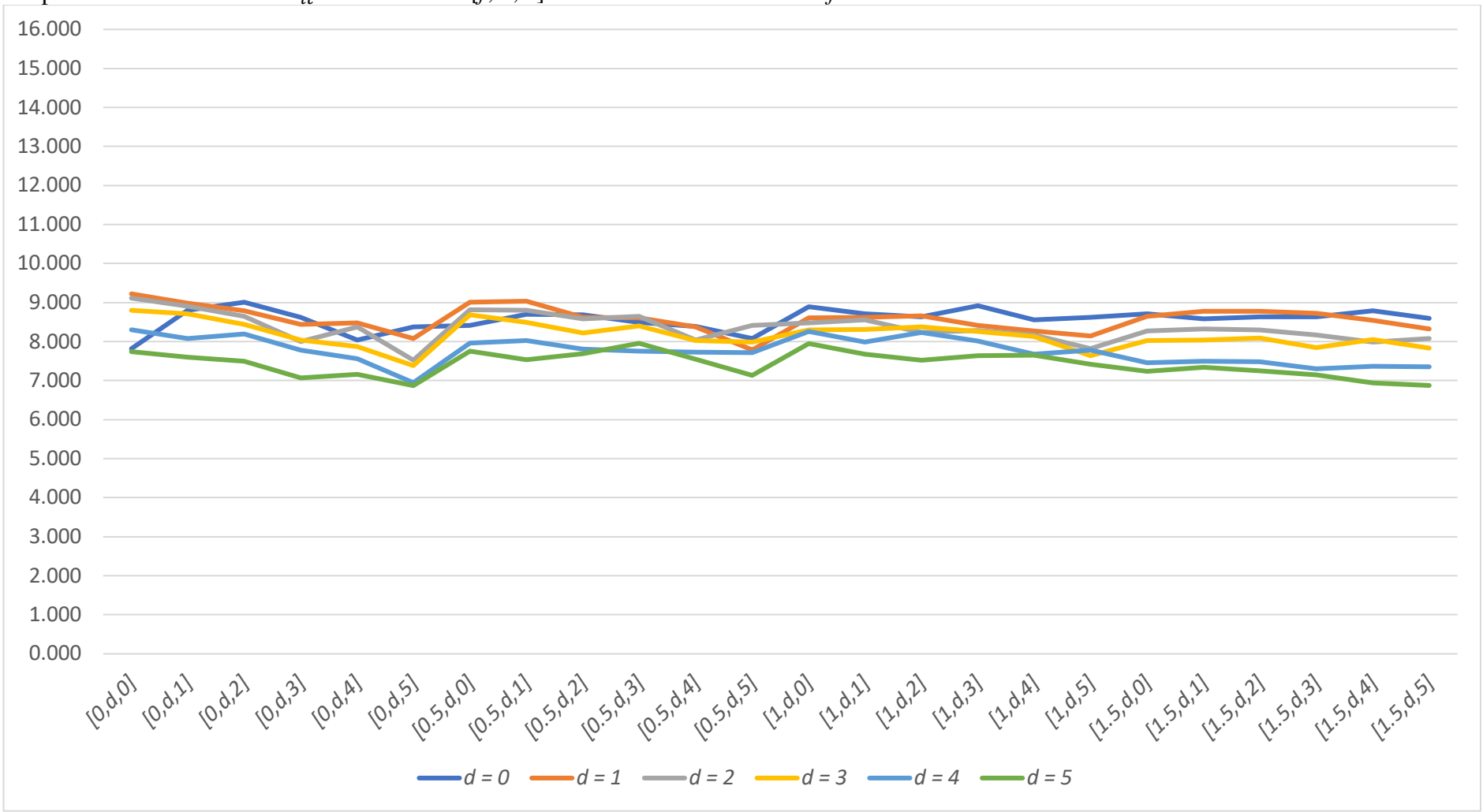


**Figure 22: EW Real Estate [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.

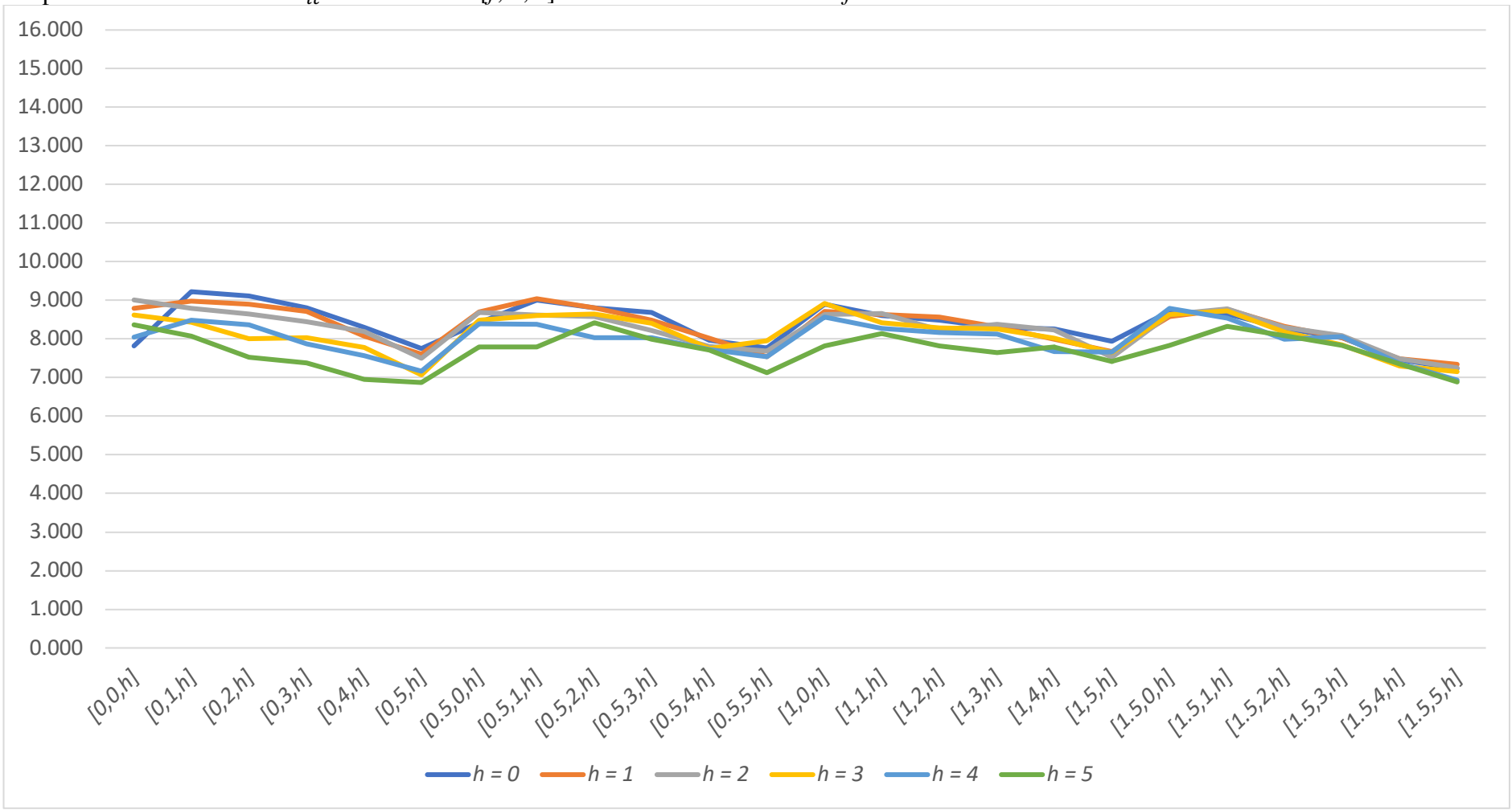


**Table 86: EW Real Estate [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

*f = 0*

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.819*** | 8.797*** | 9.010*** | 8.618*** | 8.042*** | 8.372*** |
| 1 | 9.224*** | 8.984*** | 8.794*** | 8.438*** | 8.484*** | 8.078*** |
| 2 | 9.115*** | 8.903*** | 8.644*** | 8.003*** | 8.372*** | 7.525*** |
| 3 | 8.802*** | 8.717*** | 8.440*** | 8.036*** | 7.877*** | 7.385*** |
| 4 | 8.303*** | 8.077*** | 8.194*** | 7.776*** | 7.562*** | 6.948*** |
| 5 | 7.749*** | 7.601*** | 7.501*** | 7.070*** | 7.163*** | 6.872*** |

*f = 0.5*

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.421*** | 8.698*** | 8.684*** | 8.490*** | 8.393*** | 8.084*** |
| 1 | 9.010*** | 9.042*** | 8.621*** | 8.606*** | 8.375*** | 7.788*** |
| 2 | 8.811*** | 8.803*** | 8.582*** | 8.650*** | 8.037*** | 8.420*** |
| 3 | 8.689*** | 8.492*** | 8.223*** | 8.406*** | 8.028*** | 7.989*** |
| 4 | 7.968*** | 8.025*** | 7.807*** | 7.758*** | 7.726*** | 7.719*** |
| 5 | 7.762*** | 7.542*** | 7.690*** | 7.957*** | 7.544*** | 7.131*** |

*f = 1*

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.896*** | 9.224*** | 8.984*** | 8.794*** | 8.438*** | 8.484*** |
| 1 | 8.607*** | 8.628*** | 8.660*** | 8.421*** | 8.279*** | 8.141*** |
| 2 | 8.484*** | 8.560*** | 8.231*** | 8.287*** | 8.167*** | 7.823*** |
| 3 | 8.302*** | 8.307*** | 8.383*** | 8.254*** | 8.128*** | 7.643*** |
| 4 | 8.266*** | 7.989*** | 8.238*** | 8.020*** | 7.679*** | 7.787*** |
| 5 | 7.944*** | 7.672*** | 7.520*** | 7.646*** | 7.658*** | 7.416*** |

*f = 1.5*

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.710*** | 9.010*** | 9.042*** | 8.621*** | 8.606*** | 8.375*** |
| 1 | 8.645*** | 8.771*** | 8.775*** | 8.730*** | 8.543*** | 8.323*** |
| 2 | 8.271*** | 8.331*** | 8.304*** | 8.176*** | 7.995*** | 8.082*** |
| 3 | 8.030*** | 8.036*** | 8.086*** | 7.850*** | 8.058*** | 7.828*** |
| 4 | 7.462*** | 7.493*** | 7.483*** | 7.302*** | 7.373*** | 7.350*** |
| 5 | 7.236*** | 7.343*** | 7.253*** | 7.149*** | 6.935*** | 6.881*** |

Firstly, the MA abnormal return performance in almost all cases declines as [*f*, *d*, *h*] increases from [*0*, *0*, *0*] to [*1.5*, *5*, *5*]. Secondly, the results continue to show the importance of buying and selling the asset when the MA signal occurs as any delay causes a performance drop. Thirdly, investors cannot afford to miss signals and hold an asset position longer than necessary. Finally, a fixed percentage differential before a signal is triggered does diminish performance but the effect is not as large as expected.

As in Section 5.3, to simplify the performance interactions in the tables and figures above refer to the percentage changes found in Table 87 and 88.

**Table 87: VW Real Estate [*f*, *d*, *h*] Interactions**

| | ***f*** | | | |
|---|---|---|---|---|
| | **0** | **0.5** | **1** | **1.5** |
| ***max Δh, d = 0*** | -12.84% | -14.94% | -10.68% | -8.71% |
| ***max Δd, h = 0*** | -17.11% | -17.34% | -14.96% | -20.11% |
| ***max Δh & Δd*** | -18.85% | -19.74% | -15.91% | -17.53% |

**Table 88: EW Real Estate [*f*, *d*, *h*] Interactions**

| | ***f*** | | | |
|---|---|---|---|---|
| | **0** | **0.5** | **1** | **1.5** |
| ***max Δh, d = 0*** | 7.07% | -4.00% | -4.63% | -3.85% |
| ***max Δd, h = 0*** | -0.90% | -7.83% | -10.70% | -16.92% |
| ***max Δh & Δd*** | -12.11% | -15.32% | -16.64% | -21.00% |

As can be seen in Table 87 and 88, in addition to the findings in Section 5.3, the excess return performance changes for the MA are far larger for changes in *d* relative to *h* and *f* in almost all cases.

It should be noted, while not reported in the tables and figures, the *BETC*6* is above 50 basis points but diminishes as the [*f*, *d*, *h*] values increase.

## 5.5 Conclusion

The results reported and discussed in Section 5 show [*f*, *d*, *h*] variables all play a role in the performance of the MA relative to the BH. The MA maximises its excess return performance by trading as quickly as possible once a signal occurs. Delaying the buy or sell for any reason will only result in lower returns to the investor.

The greatest performance reduction is caused by requiring the MA to be above or below the BH for a fixed number of days *d* prior to buying or selling. This is a logical outcome as waiting until the MA has remained below (above) the BH for a set number of days, the longer an investor waits to buy (sell). This creates a situation whereby the investor is entering or exiting the asset too late to maximise gains or minimise losses.

The results also provided evidence *f* does play a role in MA performance, but it is not as pronounced as expected. Waiting for the MA to be below (above) the BH for a buy (sell) signal by a fixed percentage may give an investor the impression it will reduce the risk of the MA providing a false signal to buy or sell, similar to *d* but using a percentage differential rather than trading days. However, the results show the MA performance does not improve, with reductions in excess returns as *f* increases. One thing to consider here is the difference *f* and *d* have on performance. It is reasonable to assume, given changes to *d* have a greater effect on performance, the MA is able to predict price movements that are realised over days, not small, fixed percentage amounts. If the MA was only picking up on small upward and downward swings it would be assumed *f* would have a much greater impact on performance than *d.*

The findings also show an investor must not hold a position for longer than required, as again the performance declines for changes in holding days *h* after a buy or sell signal. However,

the performance drop in this case is less pronounced than delaying due to a fixed number of days *d*. As stated previously, the biggest performance differential occurs when delaying the buy or sell. In the case of holding days *h*, comparing the results shows a reverse MA signal is unlikely to occur immediately after a buy or sell, resulting in holding not causing a significant drop in performance.

The analysis in Section 5, in addition to the tables, figures and appendices show a clear pattern as [*f, d, h*] increases from [*0, 0, 0*] to [*1.5, 5, 5*]. The pattern of performance reduction appears to be more pronounced the higher the base-cases [*0, 0, 0*] statistically significant alpha. As MA excess return performance declines, usually caused by size and book-to-market increasing, the relationship between [*f, d, h*] and performance diminishes. This is further supported by the quintiles and indices not included in the appendices. The performance pattern for changes in [*f, d, h*] are maintained but diminish and flatten with very little variation as the alphas decrease and/or become statistically insignificant for the base-case.

This finding is important. It is further evidence of the risk-reducing benefits of the MA which is maintained for all [*f, d, h*] scenarios. Even for indices and quintiles where the MA does not improve performance relative to the BH, the risk reducing benefits are pronounced. Even when introducing high levels of delay to an unprofitable MA, it does not cause significant negative performance. The downside protection of the MA is universal, supporting the findings of Glabadanidis (2017) who found evidence the MA mimics the performance of a protective put strategy.

Overall, the findings show the MA can achieve positive statistically significant returns robust to delays of up to 10 trading days, given the worst-case scenario is a 5 day wait *d* and a 5 day hold *h*. The performance however does diminish.

The biggest hinderance to performance of the MA is how quickly an investor can react when an MA signal occurs. The implication is, in order to maximise gains an investor should be monitoring the asset price daily if not more frequently and trading accordingly. Given the advances in technology in general, how easy it is to trade, and with complex programs able to monitor live information instantly, traders are likely already using the MA or other TA indicators in this manner.

# 6.0 Dissertation Conclusion

Analysis and discussion in the previous sections has focused on five key topics, Developed Market indices, US Industry indices, Cryptocurrencies, Volatility indices and MA trading delays and its effect on performance.

Reviewing the results of the MA on Developed Market indices in Section 2, a clear negative relationship exists between asset size and MA excess return performance. This implies the MA is better able to generate returns after cost from predicting price movements for assets with higher price volatility and lower trade volume. The closer the asset size approaches mid to large, the lower the excess return becomes.

The performance differential between the MA and BH appears to be somewhat persistent through time. However, when reviewing the subperiod analysis, there is a large drop off in performance over the last couple decades. The Japan and North America indices in particular, with positive excess performance disappearing in all but the smallest sized, lowest book-to-market quintiles. The overall Developed Index does have statistically significant excess returns persistent through time, although this is due to the consistently high performance for the Asia Pacific excluding Japan Index.

This has potential for future research, with analysis focusing on smaller individual time periods in the last couple decades and what is altering performance for the MA across regions, such as the performance differential between North America and the Asia Pacific. Research focus can also be placed on access and innovation of trading technology and its effect on performance. Technology has changed dramatically in the last couple decades and has enabled investors, more so retail, access to daily trading like never before. Coupled with the surge in popularity of Exchange Traded Funds (ETFs), especially in the US market in the

last decade, it is reasonable to assume market efficiency has increased (Madhavan 2014), information asymmetry and processing is declining, resulting in reduced performance for the MA relative to the BH.

Reviewing the results of the MA on US Industry indices in Section 3, the clear best performing industry across the entire time horizon is Real Estate for value weighted and Hardware for equal weighted. However, the results across subperiods are not robust, with all the top ten performers unable to maintain the same performance levels in the second subperiod versus the first, although positive statistically significant results still do occur.

The performance drops for all Industry indices in the second subperiod is far less pronounced for equal weighted. Using equal weighted for each Industry index will increase the weight in small sized assets and decrease the weight in large sized assets. Given the findings of Section 2, with a negative relationship between size and MA performance, equal outperforming value is not unexpected.

An avenue for future research is to analyse each industry separately using portfolios sorted on size. The hypothesis for this future research would be there is significantly higher performance for the smaller portfolios across each individual industry, with a continued performance drop off through time, less pronounced for small sized portfolios.

Reviewing the results for both Section 2 and 3 in relation to value and equal weights, value appears to outperform equal when sorted by asset size. However, an investor would be better of investing in equal for indices not sorted on size as the investment will have a higher weighting in small sized assets.

Reviewing the results of the MA on cryptocurrencies in Section 4, the MA does not appear to be able to consistently outperform the BH for a purely speculative asset class with zero

intrinsic value. Given the findings of Han, Yang and Zhou (2013) and Glabadanidis (2017) showing a positive relationship between MA performance and volatility it is interesting the MA cannot achieve positive statistically significant excess performance for such an asset based on extreme volatility. It is likely that while the MA and volatility are positively correlated, the MA requires a consistent level of volatility. When the volatility bounces around a lot it is harder for the MA to predict future market movements.

An avenue for future research for cryptocurrencies is to redo and enhance the analysis completed above once the time horizon has significantly improved, given cryptocurrency is still a considerably new asset class. The research can also be broadened to include many other cryptocurrencies. Future research can also look into the effect volatility on volatility and its implications for the MA and TA in general.

Reviewing the results of the MA on volatility indices in Section 4, the excess return performance was statistically significant and negative. This finding has incredibly interesting implications, given how volatility indices derive their value. Essentially, the MA is picking up on market volatility in reverse. When a buy signal is generated, it is signally the market is currently moving towards a higher level of volatility and an investor should actually sell. When a sell signal is generated, it is signally the market is currently moving towards a lower level of volatility and an investor should actually buy.

Thus, an avenue for future research is to attempt to utilise this inverse relationship to predict future market movements. For instance, research could be conducted on a volatility index MA signal and whether you can trade the underlying such as *VIX* and the *S&P500* or the futures on the index via the signal. Can this strategy achieve persistent excess return performance for the MA relative to the BH?

Reviewing the results of the MA on the delaying effects of [*f*, *d*, *h*] in Section 5, the performance of the MA does decline as expected for each delaying effect used. Overall, the greatest decline occurs from waiting after a buy or sell signal occurs before implementation. Remarkably, the delay signals do not overly drop performance into the negative for MA strategies that are unable to outperform the BH for the base-case [*0*, *0*, *0*]. This is further evidence of the protective nature of the MA against negative performance, as per the findings of Glabadanidis (2017) with the MA mimicking a protective put strategy.

An avenue of future research relating to the delay effects can study the MA performance on intra-day price movements and the MA. How does the MA perform using intraday prices rather than daily close prices? If positive excess returns are possible, how is this performance altered by small delays in trading? Will current and potential future advances in technology with complex programs able to monitor live information instantly enable intraday successful MA trading? One of the roadblocks in this avenue of research is the sheer volume of trading data required to analyse intraday price movements over a sufficient time horizon.

The most important finding across all of the results is the risk reducing benefits of the MA relative to the BH. Its ability to significantly reduce the standard deviation of returns irrespective of asset characteristic is astonishing. For a strategy that has been labelled "patently false" (Malkiel 1981, pp. 127-128), it has a robust ability to reduce risk. As per the findings of Glabadanidis (2017), the MA protects an investor from negative performance in much the same way a protective put strategy protects an investor. The risk reduction for cryptocurrency in particular is staggering, given its high degree of volatility.

It should be noted, while the MA has large risk reducing benefits relative to the BH, the BH has no realised downside risk until an investor needs to liquidate their position. Thus, when discussing the risk reducing benefits it really only applies to fund managers, shorter term

investors and day traders. Long term BH investors will almost always be better of using a simple BH strategy. It is only really when selling that the MA can prove useful to long term BH investors, providing a slightly more informed decision on when to divest.

An avenue of future research should focus on fund managers and day traders similar to the approach by Menkhoff (2010). For academics to understand TA it is important to understand its use by practitioners. While this would be difficult to ascertain given the secrecy fund managers and day traders place on their strategies, attempting to unlock TA usage and methodology patterns could assist academics in understanding its effect on market price efficiency.

Given the declining performance of the MA since the 1990s, it has become less of an effective strategy on its own. However, it does have information and risk reducing value. The implication, the MA adds value to investor decision making. Therefore, the MA is best used in conjunction with fundamental analysis as supportive information (Neely et al. 2014). The evidence supports the findings of Menkhoff (2010) who found 87% of fund managers use technical analysis to some degree. The MA provides informative analysis on an assets projected price movement, with increased success for assets with higher levels of information asymmetry such as small capitalised assets. Additionally, the MA can be used to help make a decision on the best time to buy-in or sell-out of an asset if an investor has plans in the near term, given the MA and its ability to soften risk.

In summarising this dissertation, the fundamental question for Technical Analysis and the Moving Average needs to be answered. Is the Moving Average usefulness fact, fiction or somewhere in between? Based on all the above findings and analysis, the answer is most certainly somewhere in between. An investor will always be better off using it to some degree, potentially gaining something, rather than not using it, gaining nothing. The Moving

Average is similar to a protective put strategy. It provides very little downside risk but allows an investor to have huge upside potential.

# 7.0 References


Alexander, SS 1961, 'Price Movements in Speculative Markets: Trends or Random Walks', *Industrial Management Review*, no. 2, pp. 7-26.

Balduzzi, P & Lynch, AW 1999, 'Transaction costs and predictability: some utility cost calculations', *Journal of Financial Economics*, vol. 52, no. 1, pp. 47-78.

Balduzzi, P & Lynch, AW 2000, 'Predictability and Transaction Costs: The Impact on Rebalancing Rules and Behavior', *The Journal of Finance*, vol. 55, no. 5, pp. 2285-2309.

Black, F 1986, 'Noise', *The Journal of Finance*, vol. 41, no. 3, pp. 529-543.

Brock, W, Lakonishok, J & LeBaron, B 1992, 'Simple Technical Trading Rules and the Stochastic Properties of Stock Returns', *The Journal of Finance*, vol. 47, no. 5, pp. 1731-1764.

Carhart, MM 1997, 'On Persistence in Mutual Fund Performance', *The Journal of Finance*, vol. 52, no. 1, pp. 57-82.

Chan, LKC, Jegadeesh, N & Lakonishok, J 1996, 'Momentum Strategies', *The Journal of Finance*, vol. 51, no. 5, pp. 1681-1713.

Cootner, PH 1962, *Stock Prices: Random Vs. Systematic Changes*, Industrial Management Review.

Corrado, CJ & Lee, SH 1992, 'Filter rule tests of the economic significance of serial dependencies in daily stock returns', *Journal of Financial Research*, vol. 15, no. 4, pp. 369-387.

*Cryptocurrencies* 2020, Reserve Bank of Australia, <https://www.rba.gov.au/education/resources/explainers/cryptocurrencies.html>.

Dale, C & Rosemarie, W 1980, 'The Arc Sine Law and the Treasury Bill Futures Market', *Financial Analysts Journal*, vol. 36, no. 6, pp. 71-74.

Detzel, A, Liu, H, Strauss, J, Zhou, G & Zhu, Y 2021, 'Learning and predictability via technical analysis: Evidence from bitcoin and stocks with hard-to-value fundamentals', *Financial Management*, vol. 50, no. 1, pp. 107-137.

Donchian, RD 1960, 'Commodities: High Finance in Copper', *Financial Analysts Journal*, vol. 16, no. 6, pp. 133-142.

Edwards, RD, Magee, J & Bassetti, WHC 2012, *Technical Analysis of Stock Trends, Tenth Edition*, CRC Press.

Faber, MT 2009, 'A Quantitative Approach to Tactical Asset Allocation', *Journal of Wealth Management, Spring 2007*.

Fama, EF 1970, 'Efficient Capital Markets: A Review of Theory and Empirical Work', *The Journal of Finance*, vol. 25, no. 2, pp. 383-417.

Fama, EF 1995, 'Random Walks in Stock Market Prices', *Financial Analysts Journal*, vol. 51, no. 1, pp. 75-80.

Fama, EF & Blume, ME 1966, 'Filter Rules and Stock-Market Trading', *The Journal of Business*, vol. 39, no. 1, pp. 226-241.

Fama, EF & French, KR 1992, 'The Cross-Section of Expected Stock Returns', *The Journal of Finance*, vol. 47, no. 2, pp. 427-465.

Fama, EF & French, KR 1993, 'Common risk factors in the returns on stocks and bonds', *Journal of Financial Economics*, vol. 33, no. 1, pp. 3-56.

French, KR 2018, *Data Library*, <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html>.

Glabadanidis, P 2014, 'The Market Timing Power of Moving Averages: Evidence from US REITs and REIT Indexes', *International Review of Finance*, vol. 14, no. 2, pp. 161-202.

Glabadanidis, P 2015, 'Market Timing With Moving Averages', *International Review of Finance*, vol. 15, no. 3, pp. 387-425.

Glabadanidis, P 2017, 'Timing the market with a combination of moving averages', *International Review of Finance*, vol. 17, no. 3, pp. 353-394.

Han, Y 2006, 'Asset Allocation with a High Dimensional Latent Factor Stochastic Volatility Model', *The Review of Financial Studies*, vol. 19, no. 1, pp. 237-271.

Han, Y, Yang, K & Zhou, G 2013, 'A New Anomaly: The Cross-Sectional Profitability of Technical Analysis', *The Journal of Financial and Quantitative Analysis*, vol. 48, no. 5, pp. 1433-1461.

Henriksson, RD & Merton, RC 1981, 'On Market Timing and Investment Performance. II. Statistical Procedures for Evaluating Forecasting Skills', *The Journal of Business*, vol. 54, no. 4, pp. 513-533.

Houthakker, HS 1961, 'Systematic and Random Elements in Short-Term Price Movements', *The American Economic Review*, vol. 51, no. 2, pp. 164-172.

Irwin, SH & Uhrig, JW 1984, 'Do technical analysts have holes in their shoes?', *Review of Research in Futures Markets*, vol. 3, no. 3, pp. 264-277.

James, FE, Jr. 1968, 'Monthly Moving Averages--An Effective Investment Tool?', *The Journal of Financial and Quantitative Analysis*, vol. 3, no. 3, pp. 315-326.

Jegadeesh, N & Titman, S 1993, 'Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency', *The Journal of Finance*, vol. 48, no. 1, pp. 65-91.

Jensen, MC & Benington, GA 1970, 'Random Walks and Technical Theories: Some Additional Evidence', *The Journal of Finance*, vol. 25, no. 2, pp. 469-482.

Levy, RA 1967, 'Random Walks: Reality or Myth', *Financial Analysts Journal*, vol. 23, no. 6, pp. 69-77.

Lintner, J 1965, 'The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets', *The Review of Economics and Statistics*, vol. 47, no. 1, pp. 13-37.

Lo, AW, Mamaysky, H & Wang, J 2000, 'Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation', *The Journal of Finance*, vol. 55, no. 4, pp. 1705-1765.

Long, JBD, Shleifer, A, Summers, LH & Waldmann, RJ 1990, 'Noise Trader Risk in Financial Markets', *Journal of Political Economy*, vol. 98, no. 4, pp. 703-738.

Madhavan, A 2014, 'Exchange-Traded Funds: An Overview of Institutions, Trading, and Impacts', *Annual Review of Financial Economics*, vol. 6, pp. 311-341.

Malkiel, BG 1981, *A Random Walk Down Wall Street*, Norton.

Malkiel, BG 1989, 'Is the Stock Market Efficient?', *Science*, vol. 243, no. 4896, pp. 1313-1318.

Markowitz, H 1952, 'Portfolio Selection', *The Journal of Finance*, vol. 7, no. 1, pp. 77-91.

Menkhoff, L 2010, 'The use of technical analysis by fund managers: International evidence', *Journal of Banking & Finance*, vol. 34, no. 11, pp. 2573-2586.

Neely, C, Rapach, DE, Tu, J & Zhou, G 2014, 'Forecasting the Equity Risk Premium: The Role of Technical Indicators', *Management Science*, vol. 60, no. 7, pp. 1772-1791.

Nison, S 1991, *Japanese Candlestick Charting Techniques: A Contemporary Guide to the Ancient Investment Techniques of the Far East*, New York Institute of Finance.

Park, C-H & Irwin, SH 2007, 'What do we know about the profitability of technical analysis?', *Journal of Economic Surveys*, vol. 21, no. 4, pp. 786-826.

Pring, MJ 2002, *Technical Analysis Explained: The Successful Investor's Guide to Spotting Investment Trends and Turning Points*, McGraw-Hill Education.

Sharpe, WF 1964, 'Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk', *The Journal of Finance*, vol. 19, no. 3, pp. 425-442.

Smidt, S 1965, *A Test of the Serial Independence of Price Changes of Soybean Futures*, [Food Research Institute] Stanford University.

Sweeney, RJ 1986, 'Beating the Foreign Exchange Market', *The Journal of Finance*, vol. 41, no. 1, pp. 163-182.

Sweeney, RJ 1988, 'Some New Filter Rule Tests: Methods and Results', *The Journal of Financial and Quantitative Analysis*, vol. 23, no. 3, pp. 285-300.

Taylor, SJ 1992, 'Rewards available to currency futures speculators: compensation for risk or evidence of inefficient pricing?', *Economic Record*, vol. 68, no. S1, pp. 105-116.

Treynor, JL & Mazuy, K 1966, 'Can Mutual Funds Outguess the Market?', *Harvard Business Review*, vol. 44, pp. 131-136.

Van Horne, JC & George, GCP 1967, 'The Random-Walk Theory: An Empirical Test', *Financial Analysts Journal*, vol. 23, no. 6, pp. 87-92.

Van Horne, JC & George, GCP 1968, 'Technical Trading Rules: A Comment', *Financial Analysts Journal*, vol. 24, no. 4, pp. 128-132.

Wilder, JW 1978, *New Concepts in Technical Trading Systems*, Trend Research.

Zhu, Y & Zhou, G 2007, 'Technical Analysis and Theory of Finance', *SSRN eLibrary*.

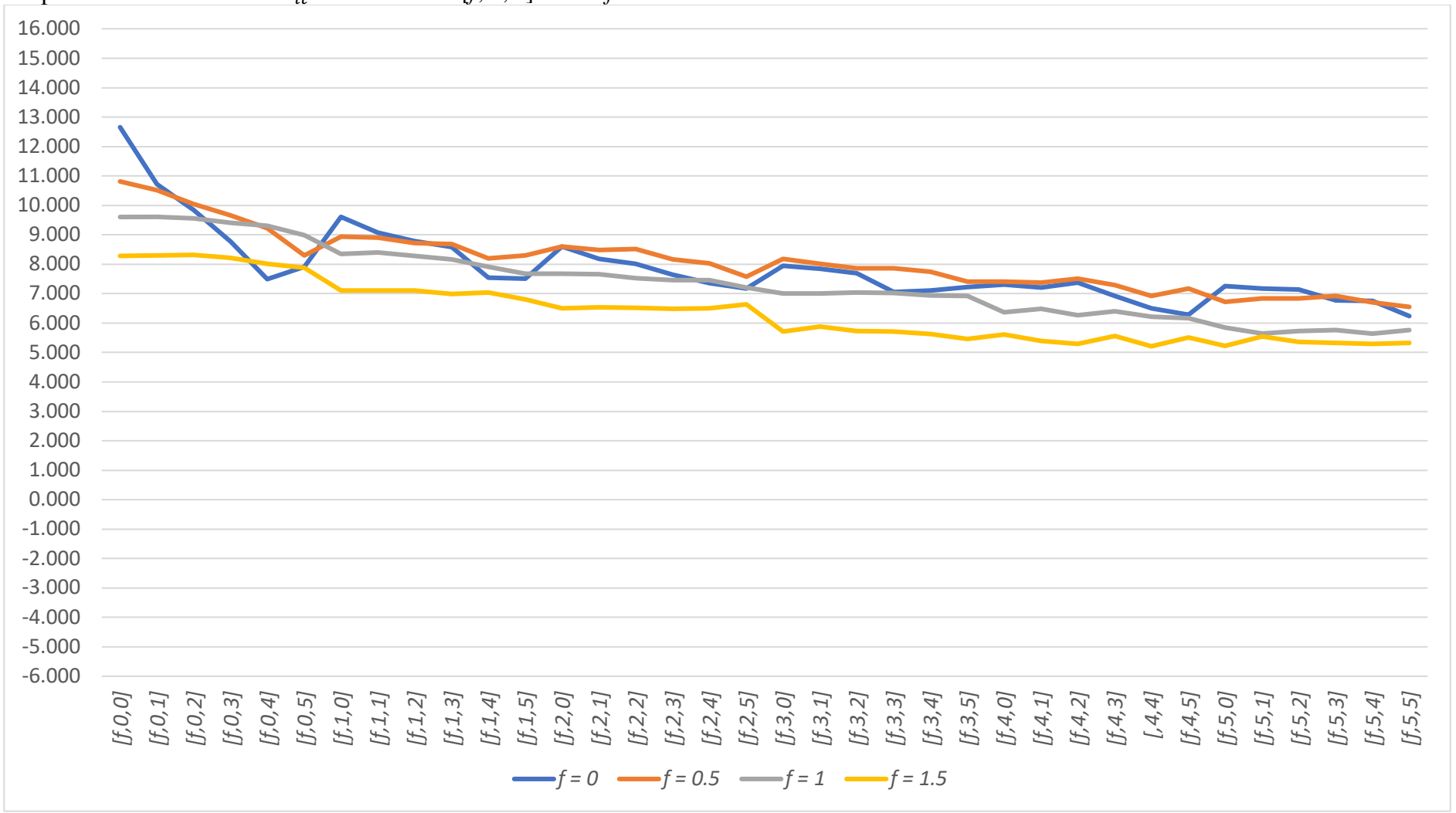
Zhu, Y & Zhou, G 2009, 'Technical analysis: An asset allocation perspective on the use of moving averages', *Journal of Financial Economics*, vol. 92, no. 3, pp. 519-544.

# 8.0 Appendices

This section contains all appendices related to the above dissertation.

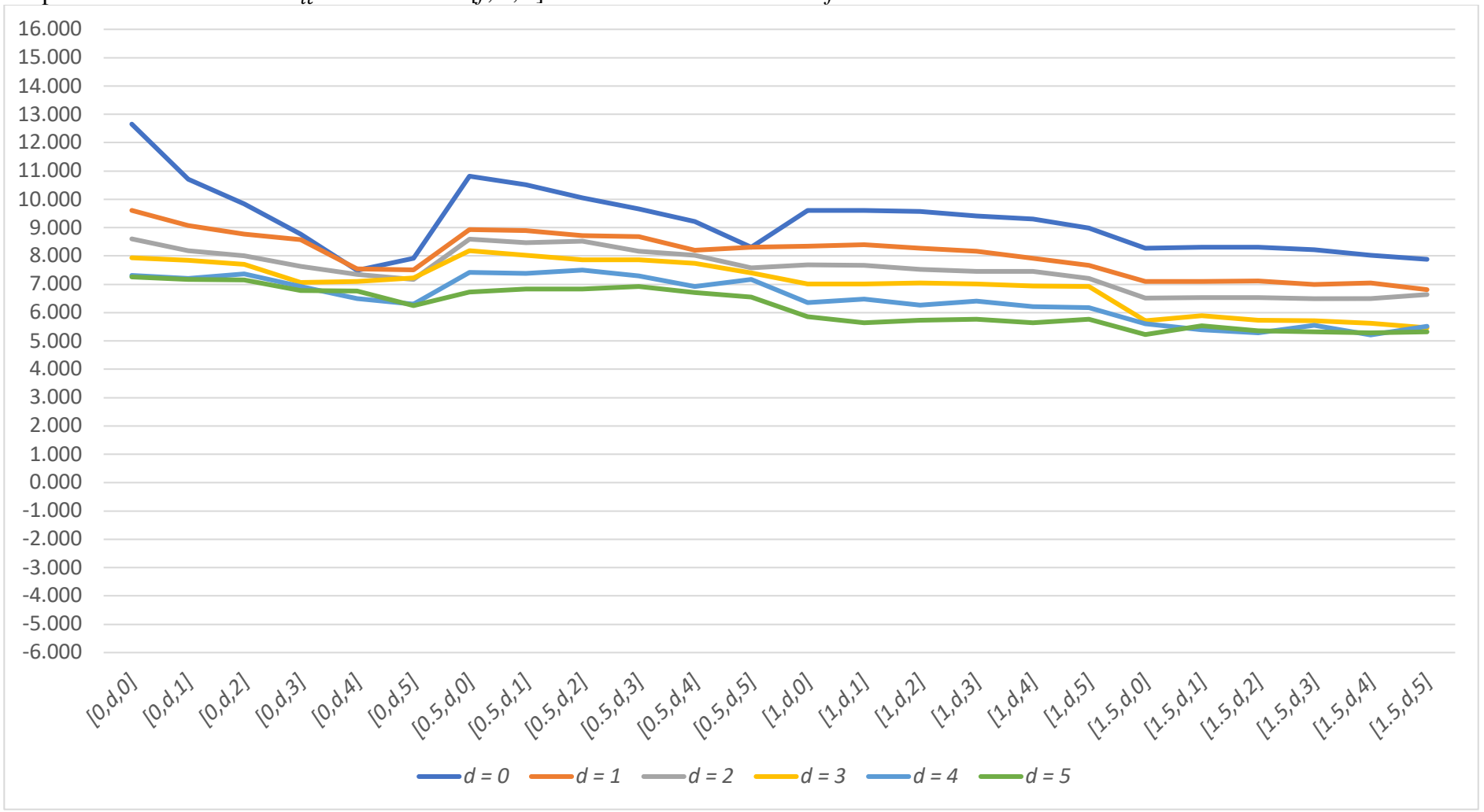
**Appendix 1: VW Developed S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



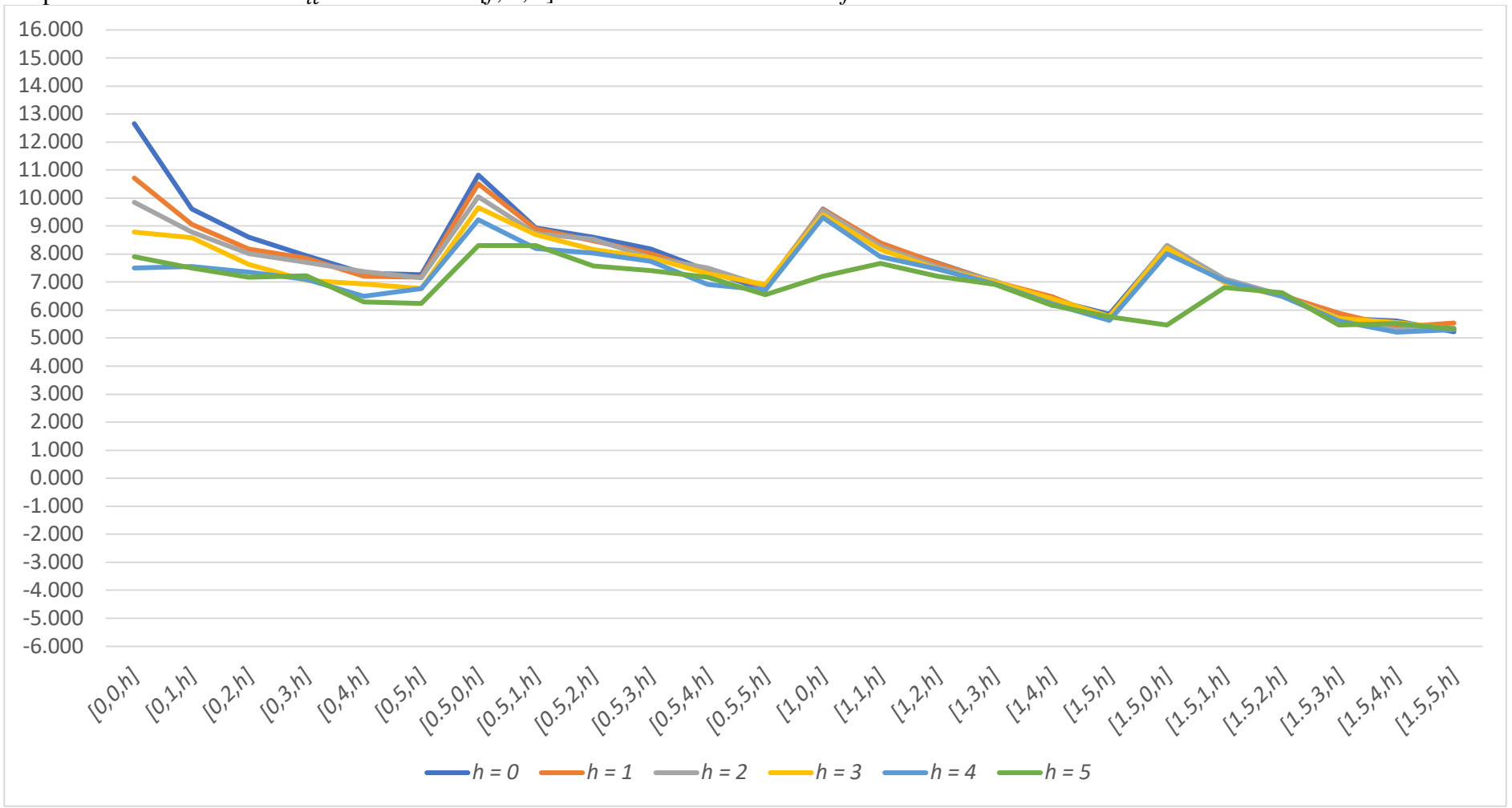
**Appendix 2: VW Developed S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 3: VW Developed S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 4: VW Developed S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.655*** | 10.714*** | 9.845*** | 8.777*** | 7.493*** | 7.911*** |
| 1 | 9.609*** | 9.067*** | 8.779*** | 8.583*** | 7.550*** | 7.502*** |
| 2 | 8.603*** | 8.188*** | 8.010*** | 7.636*** | 7.354*** | 7.175*** |
| 3 | 7.941*** | 7.854*** | 7.700*** | 7.057*** | 7.099*** | 7.218*** |
| 4 | 7.314*** | 7.215*** | 7.374*** | 6.926*** | 6.497*** | 6.292*** |
| 5 | 7.260*** | 7.174*** | 7.147*** | 6.776*** | 6.762*** | 6.239*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.813*** | 10.517*** | 10.046*** | 9.658*** | 9.223*** | 8.304*** |
| 1 | 8.933*** | 8.898*** | 8.726*** | 8.691*** | 8.203*** | 8.304*** |
| 2 | 8.597*** | 8.476*** | 8.526*** | 8.160*** | 8.030*** | 7.582*** |
| 3 | 8.186*** | 8.017*** | 7.871*** | 7.867*** | 7.745*** | 7.411*** |
| 4 | 7.412*** | 7.377*** | 7.502*** | 7.293*** | 6.922*** | 7.173*** |
| 5 | 6.720*** | 6.842*** | 6.836*** | 6.916*** | 6.705*** | 6.551*** |

***f = 1***

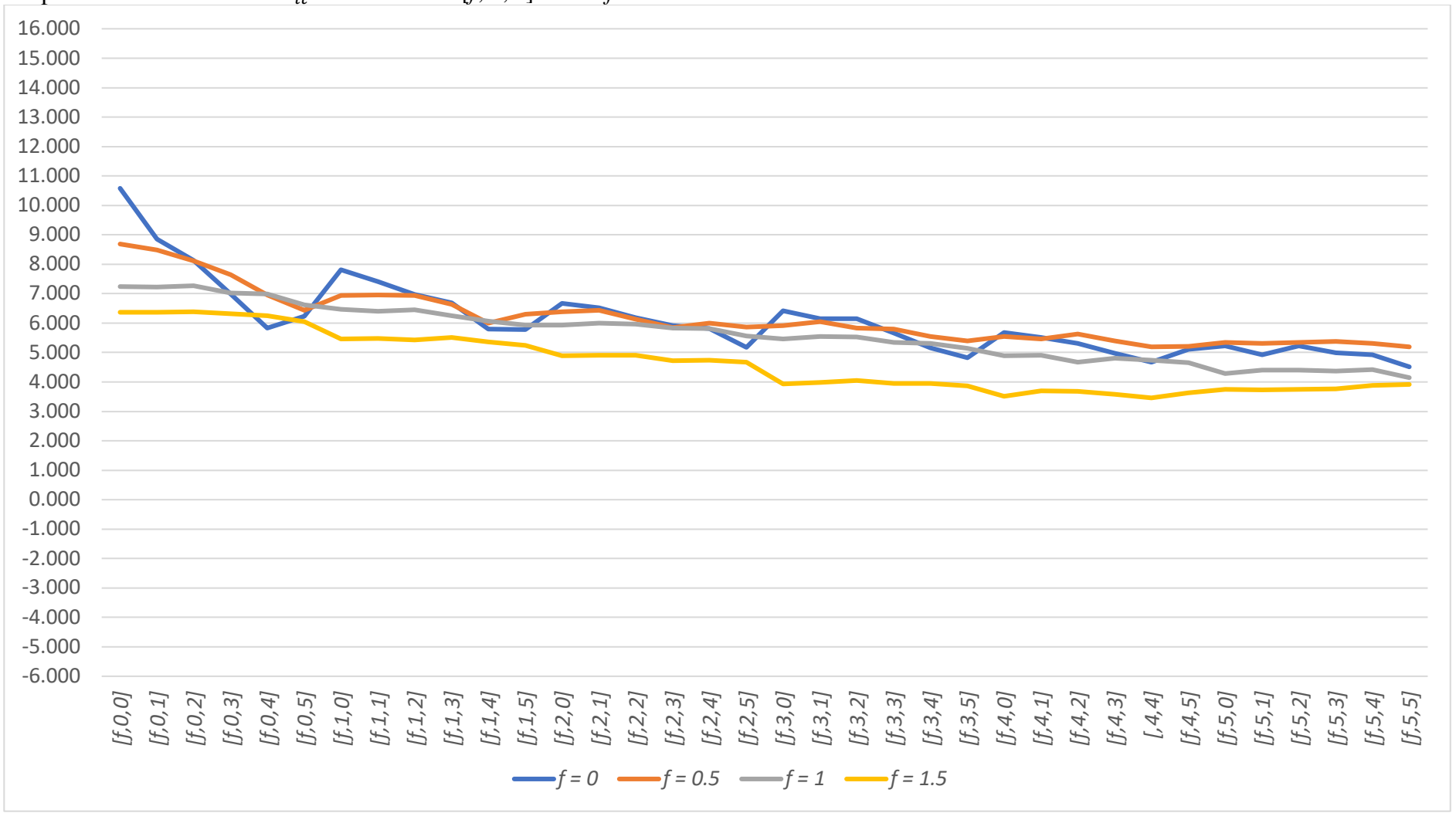
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.605*** | 9.609*** | 9.067*** | 8.779*** | 8.583*** | 7.550*** |
| 1 | 8.343*** | 8.404*** | 8.281*** | 8.160*** | 7.912*** | 7.672*** |
| 2 | 7.679*** | 7.669*** | 7.535*** | 7.461*** | 7.458*** | 7.204*** |
| 3 | 7.010*** | 7.010*** | 7.046*** | 7.016*** | 6.939*** | 6.917*** |
| 4 | 6.362*** | 6.480*** | 6.271*** | 6.404*** | 6.216*** | 6.172*** |
| 5 | 5.850*** | 5.651*** | 5.735*** | 5.771*** | 5.641*** | 5.759*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.281*** | 8.933*** | 8.898*** | 8.726*** | 8.691*** | 8.203*** |
| 1 | 7.101*** | 7.106*** | 7.112*** | 6.985*** | 7.047*** | 6.811*** |
| 2 | 6.507*** | 6.532*** | 6.526*** | 6.492*** | 6.495*** | 6.630*** |
| 3 | 5.711*** | 5.884*** | 5.724*** | 5.711*** | 5.621*** | 5.465*** |
| 4 | 5.613*** | 5.394*** | 5.290*** | 5.560*** | 5.212*** | 5.517*** |
| 5 | 5.226*** | 5.539*** | 5.362*** | 5.321*** | 5.295*** | 5.329*** |

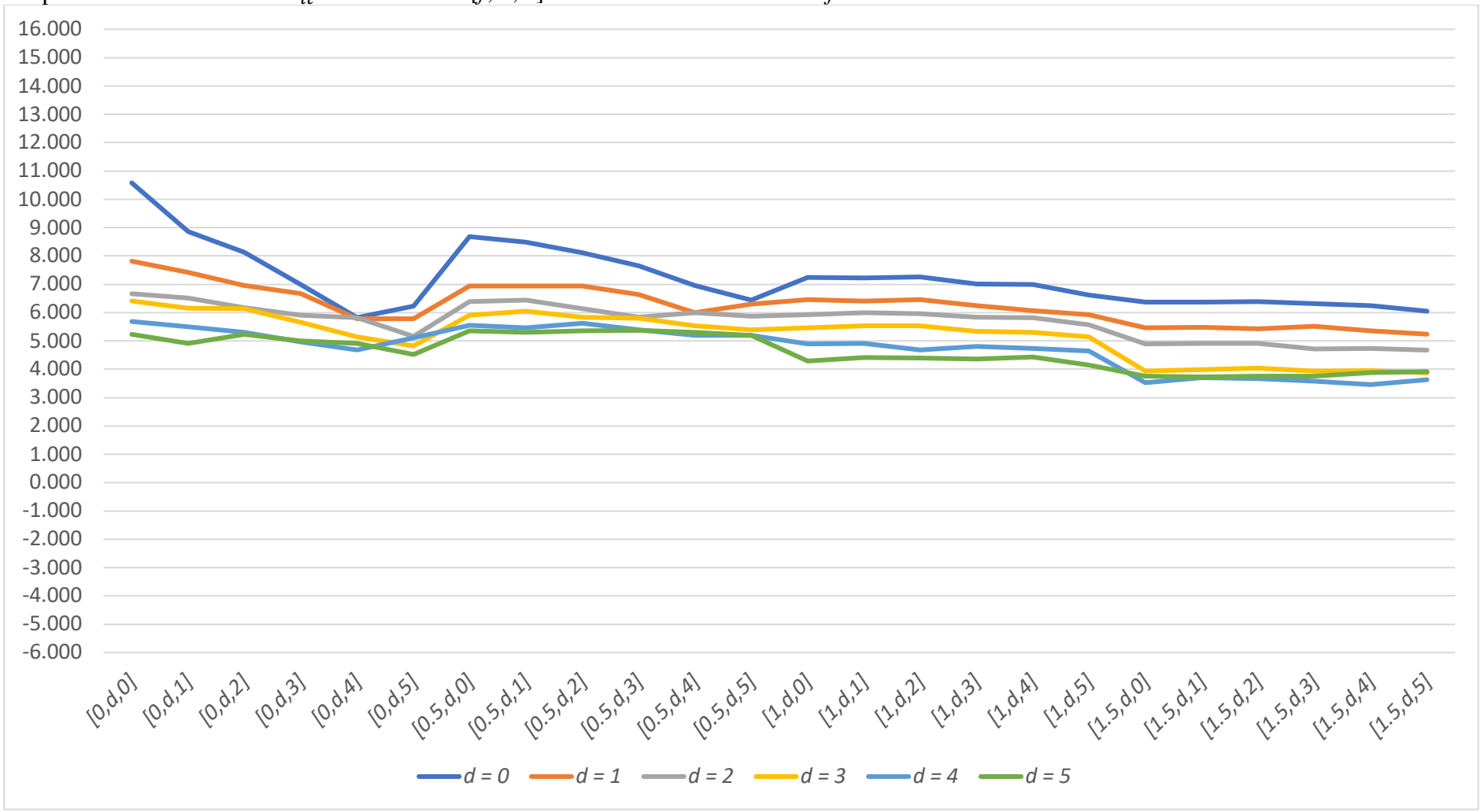
**Appendix 5: VW Developed S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



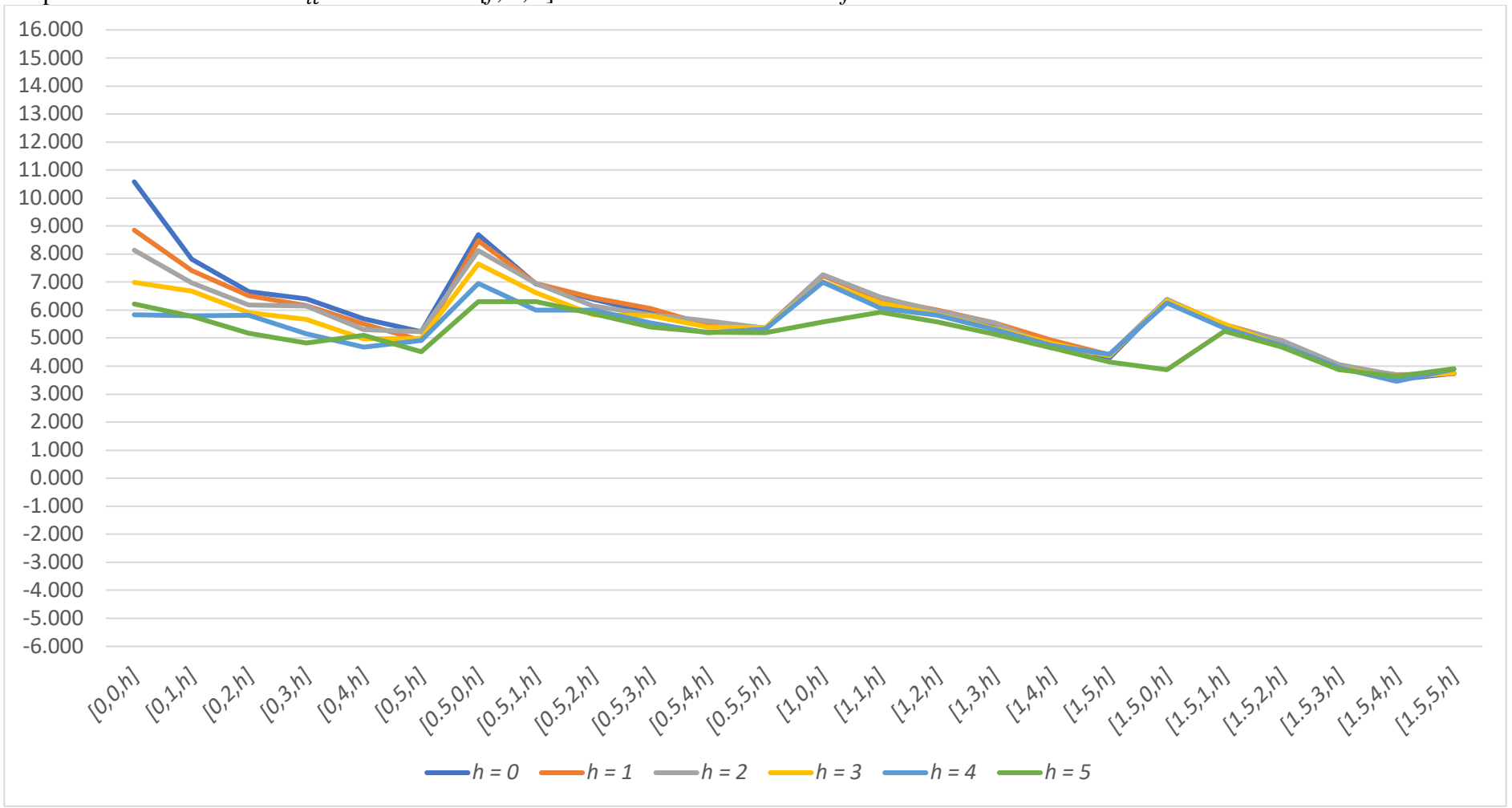
**Appendix 6: VW Developed S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 7: VW Developed S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 8: VW Developed S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.580*** | 8.853*** | 8.138*** | 6.997*** | 5.826*** | 6.227*** |
| 1 | 7.816*** | 7.414*** | 6.966*** | 6.679*** | 5.789*** | 5.776*** |
| 2 | 6.667*** | 6.515*** | 6.177*** | 5.913*** | 5.819*** | 5.170*** |
| 3 | 6.411*** | 6.158*** | 6.149*** | 5.667*** | 5.152*** | 4.827*** |
| 4 | 5.687*** | 5.508*** | 5.308*** | 4.970*** | 4.677*** | 5.106*** |
| 5 | 5.227*** | 4.917*** | 5.228*** | 4.995*** | 4.918*** | 4.514*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.687*** | 8.480*** | 8.117*** | 7.647*** | 6.957*** | 6.434*** |
| 1 | 6.935*** | 6.948*** | 6.946*** | 6.630*** | 6.005*** | 6.303*** |
| 2 | 6.392*** | 6.434*** | 6.138*** | 5.840*** | 5.996*** | 5.867*** |
| 3 | 5.912*** | 6.051*** | 5.835*** | 5.795*** | 5.540*** | 5.398*** |
| 4 | 5.549*** | 5.458*** | 5.621*** | 5.397*** | 5.193*** | 5.204*** |
| 5 | 5.352*** | 5.302*** | 5.351*** | 5.374*** | 5.313*** | 5.198*** |

***f = 1***

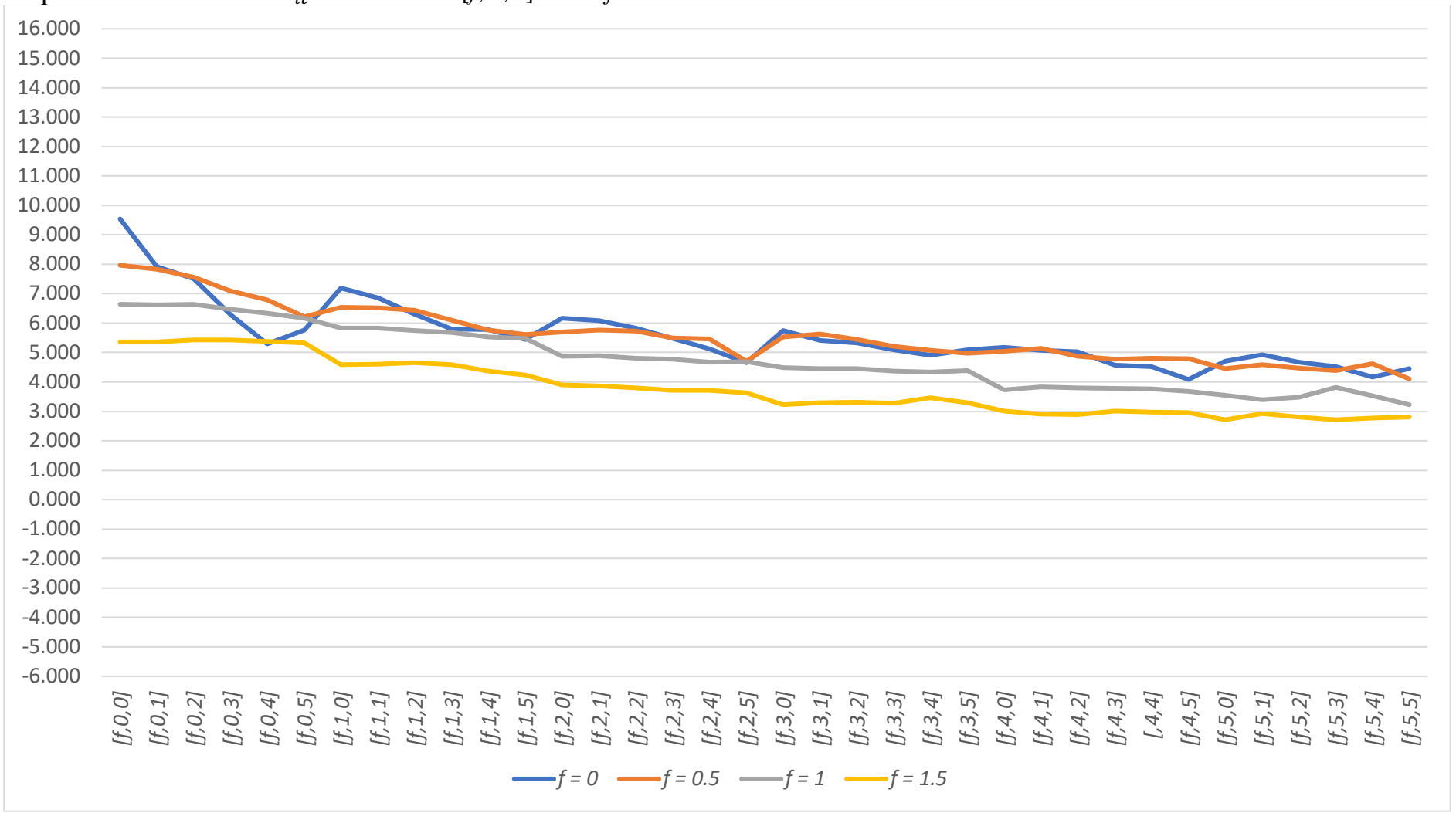
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.245*** | 7.816*** | 7.414*** | 6.966*** | 6.679*** | 5.789*** |
| 1 | 6.461*** | 6.408*** | 6.457*** | 6.254*** | 6.066*** | 5.929*** |
| 2 | 5.932*** | 5.993*** | 5.965*** | 5.838*** | 5.816*** | 5.568*** |
| 3 | 5.469*** | 5.537*** | 5.532*** | 5.346*** | 5.302*** | 5.138*** |
| 4 | 4.893*** | 4.910*** | 4.674*** | 4.813*** | 4.732*** | 4.649*** |
| 5 | 4.286*** | 4.408*** | 4.396*** | 4.371*** | 4.425*** | 4.146*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.371*** | 6.935*** | 6.948*** | 6.946*** | 6.630*** | 6.005*** |
| 1 | 5.460*** | 5.483*** | 5.433*** | 5.509*** | 5.354*** | 5.240*** |
| 2 | 4.893*** | 4.905*** | 4.908*** | 4.720*** | 4.741*** | 4.677*** |
| 3 | 3.938*** | 3.990*** | 4.050*** | 3.942*** | 3.952*** | 3.872*** |
| 4 | 3.520*** | 3.696*** | 3.676*** | 3.582*** | 3.459*** | 3.635*** |
| 5 | 3.749*** | 3.729*** | 3.749*** | 3.760*** | 3.888*** | 3.909*** |

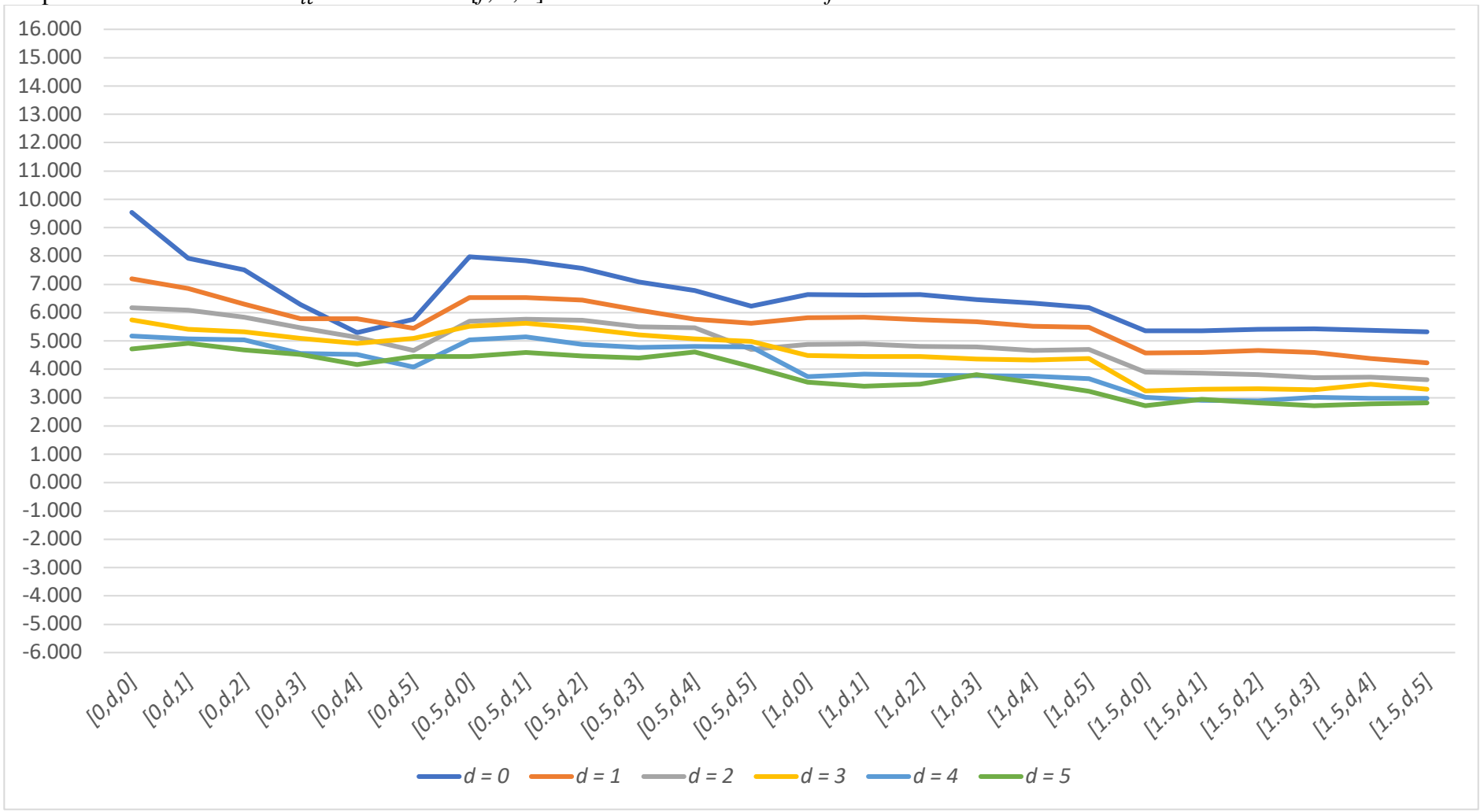
**Appendix 9: VW Developed S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



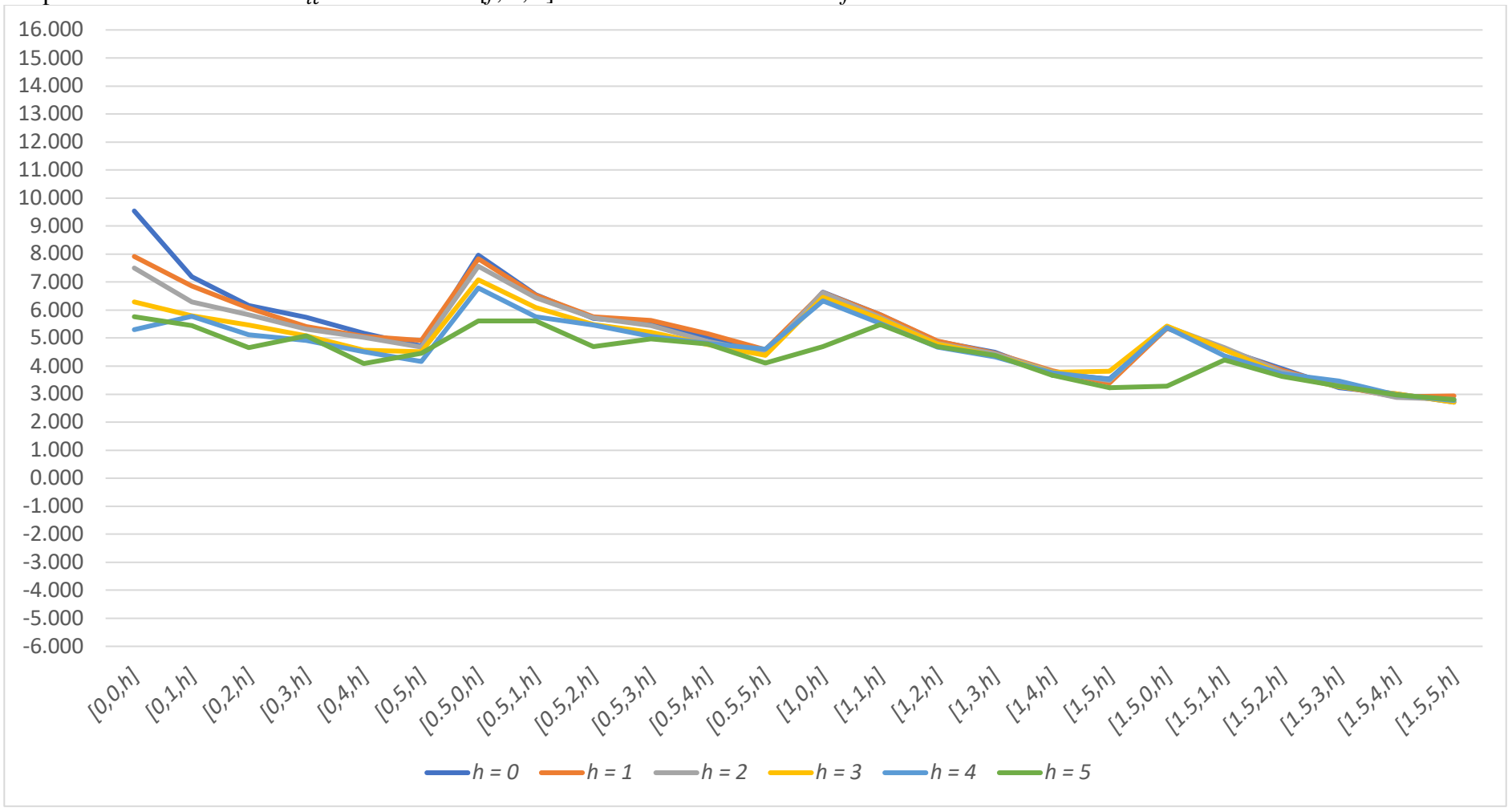
**Appendix 10: VW Developed S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 11: VW Developed S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 12: VW Developed S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.538*** | 7.914*** | 7.503*** | 6.284*** | 5.294*** | 5.764*** |
| 1 | 7.194*** | 6.855*** | 6.295*** | 5.791*** | 5.780*** | 5.441*** |
| 2 | 6.172*** | 6.080*** | 5.831*** | 5.471*** | 5.126*** | 4.657*** |
| 3 | 5.743*** | 5.418*** | 5.320*** | 5.087*** | 4.908*** | 5.086*** |
| 4 | 5.174*** | 5.067*** | 5.031*** | 4.565*** | 4.514*** | 4.086*** |
| 5 | 4.710*** | 4.918*** | 4.680*** | 4.515*** | 4.163*** | 4.453*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.966*** | 7.825*** | 7.565*** | 7.082*** | 6.789*** | 6.221*** |
| 1 | 6.540*** | 6.525*** | 6.435*** | 6.092*** | 5.758*** | 5.619*** |
| 2 | 5.701*** | 5.766*** | 5.725*** | 5.493*** | 5.458*** | 4.702*** |
| 3 | 5.522*** | 5.632*** | 5.447*** | 5.211*** | 5.067*** | 4.979*** |
| 4 | 5.046*** | 5.150*** | 4.878*** | 4.775*** | 4.813*** | 4.793*** |
| 5 | 4.446*** | 4.585*** | 4.475*** | 4.389*** | 4.614*** | 4.103*** |

***f = 1***

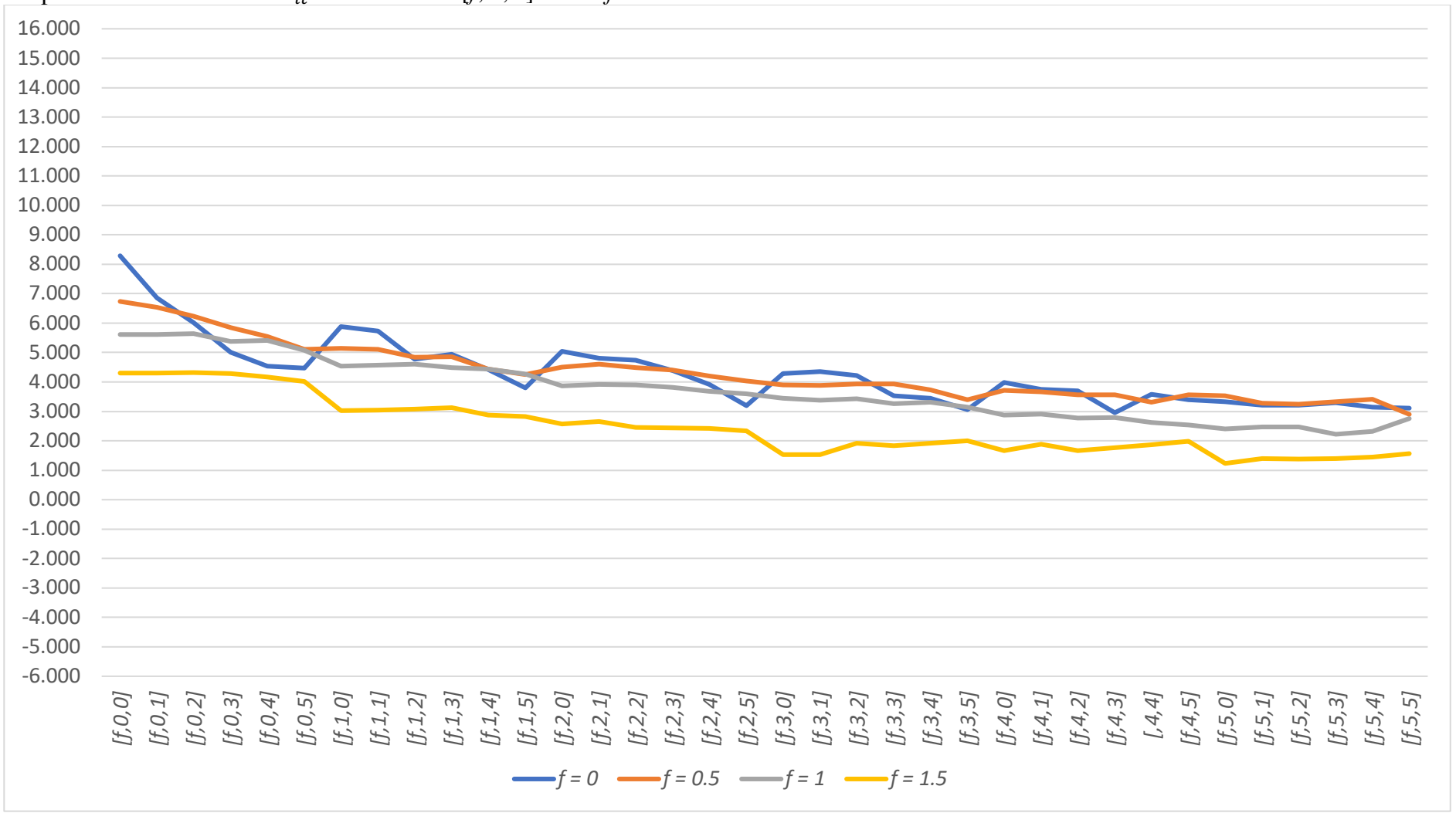
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.641*** | 7.194*** | 6.855*** | 6.295*** | 5.791*** | 5.780*** |
| 1 | 5.825*** | 5.837*** | 5.747*** | 5.678*** | 5.526*** | 5.485*** |
| 2 | 4.875*** | 4.896*** | 4.809*** | 4.780*** | 4.672*** | 4.696*** |
| 3 | 4.493*** | 4.452*** | 4.449*** | 4.362*** | 4.329*** | 4.387*** |
| 4 | 3.731*** | 3.837*** | 3.796*** | 3.784*** | 3.760*** | 3.676*** |
| 5 | 3.543*** | 3.395*** | 3.480*** | 3.810*** | 3.526*** | 3.228*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.365*** | 6.540*** | 6.525*** | 6.435*** | 6.092*** | 5.758*** |
| 1 | 4.583*** | 4.600*** | 4.659*** | 4.596*** | 4.375*** | 4.228*** |
| 2 | 3.902*** | 3.863*** | 3.805*** | 3.710*** | 3.720*** | 3.633*** |
| 3 | 3.236*** | 3.291*** | 3.316*** | 3.272*** | 3.469*** | 3.294*** |
| 4 | 3.017*** | 2.905*** | 2.885*** | 3.009*** | 2.974*** | 2.967*** |
| 5 | 2.714*** | 2.933*** | 2.812*** | 2.714*** | 2.773*** | 2.807*** |

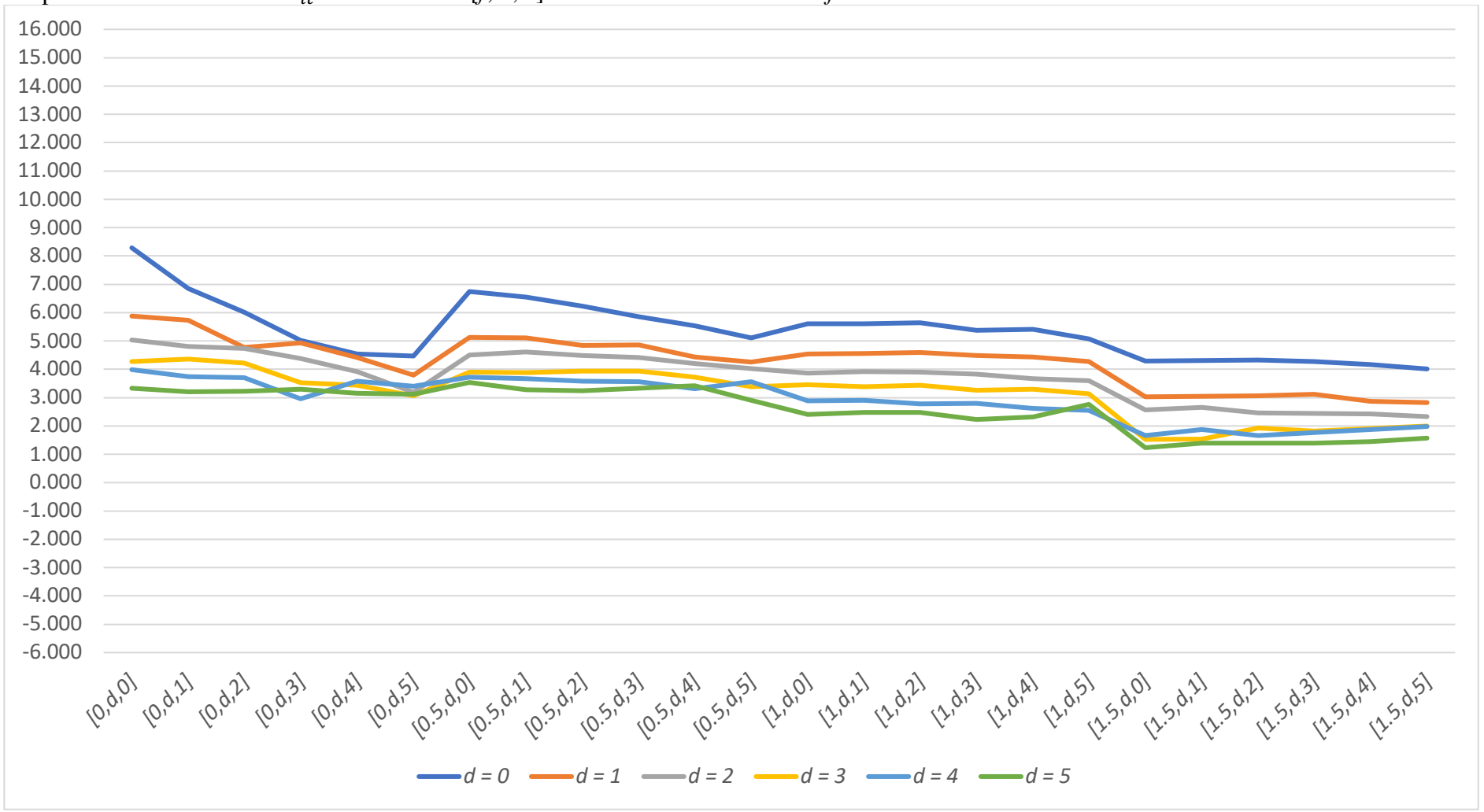
**Appendix 13: VW Developed S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



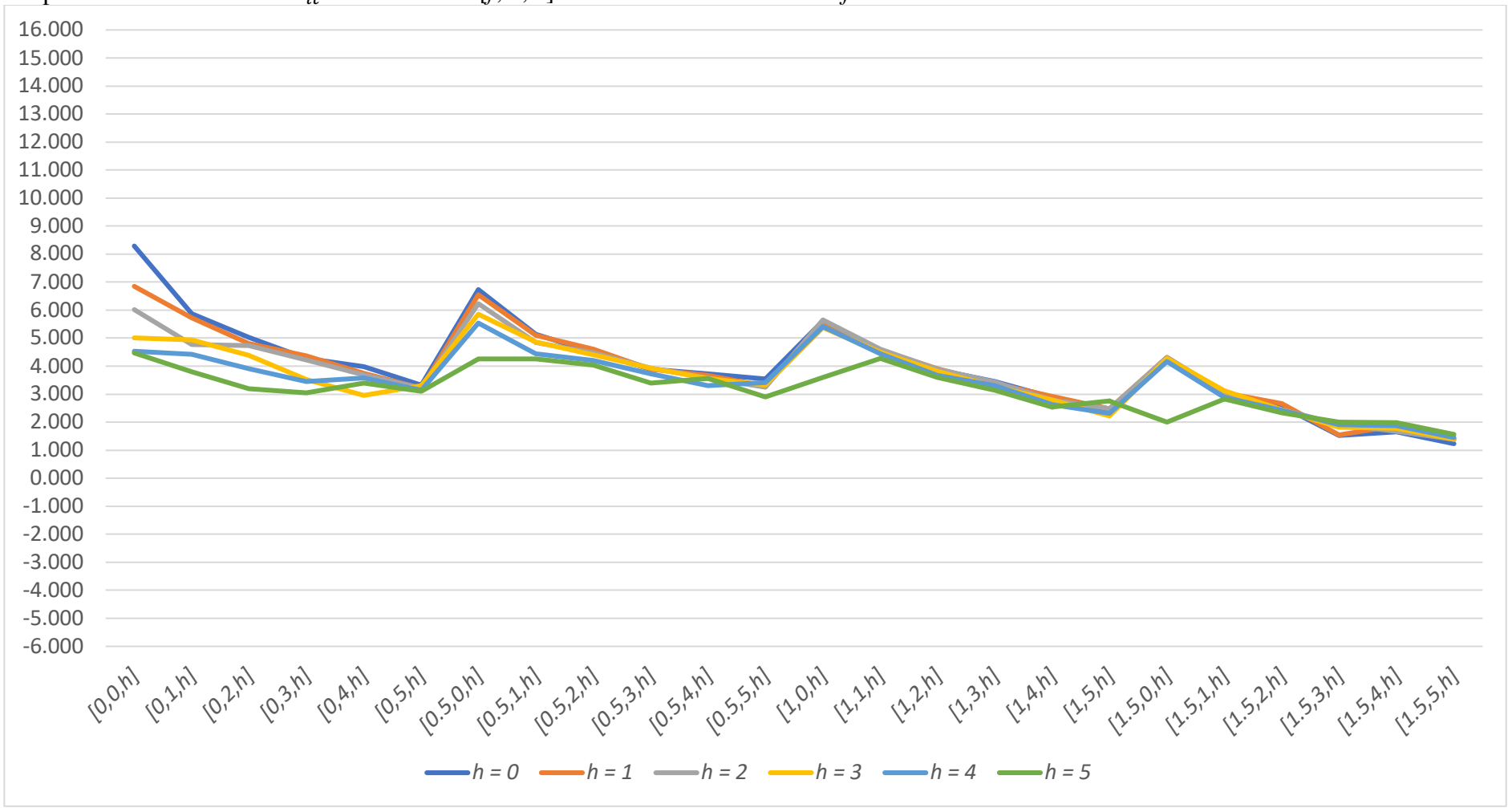
**Appendix 14: VW Developed S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 15: VW Developed S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 16: VW Developed S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.288*** | 6.849*** | 6.015*** | 5.016*** | 4.534*** | 4.471*** |
| 1 | 5.878*** | 5.725*** | 4.765*** | 4.935*** | 4.421*** | 3.801*** |
| 2 | 5.035*** | 4.805*** | 4.738*** | 4.388*** | 3.917*** | 3.187*** |
| 3 | 4.280*** | 4.360*** | 4.214*** | 3.525*** | 3.444*** | 3.056*** |
| 4 | 3.987*** | 3.747*** | 3.696*** | 2.956*** | 3.576*** | 3.398*** |
| 5 | 3.330*** | 3.213*** | 3.217*** | 3.295*** | 3.148*** | 3.110*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.736*** | 6.543*** | 6.231*** | 5.853*** | 5.539*** | 5.105*** |
| 1 | 5.134*** | 5.106*** | 4.839*** | 4.853*** | 4.435*** | 4.259*** |
| 2 | 4.496*** | 4.606*** | 4.480*** | 4.409*** | 4.203*** | 4.033*** |
| 3 | 3.899*** | 3.882*** | 3.934*** | 3.928*** | 3.727*** | 3.390*** |
| 4 | 3.720*** | 3.663*** | 3.571*** | 3.561*** | 3.313*** | 3.566*** |
| 5 | 3.535*** | 3.279*** | 3.243*** | 3.327*** | 3.420*** | 2.900*** |

***f = 1***

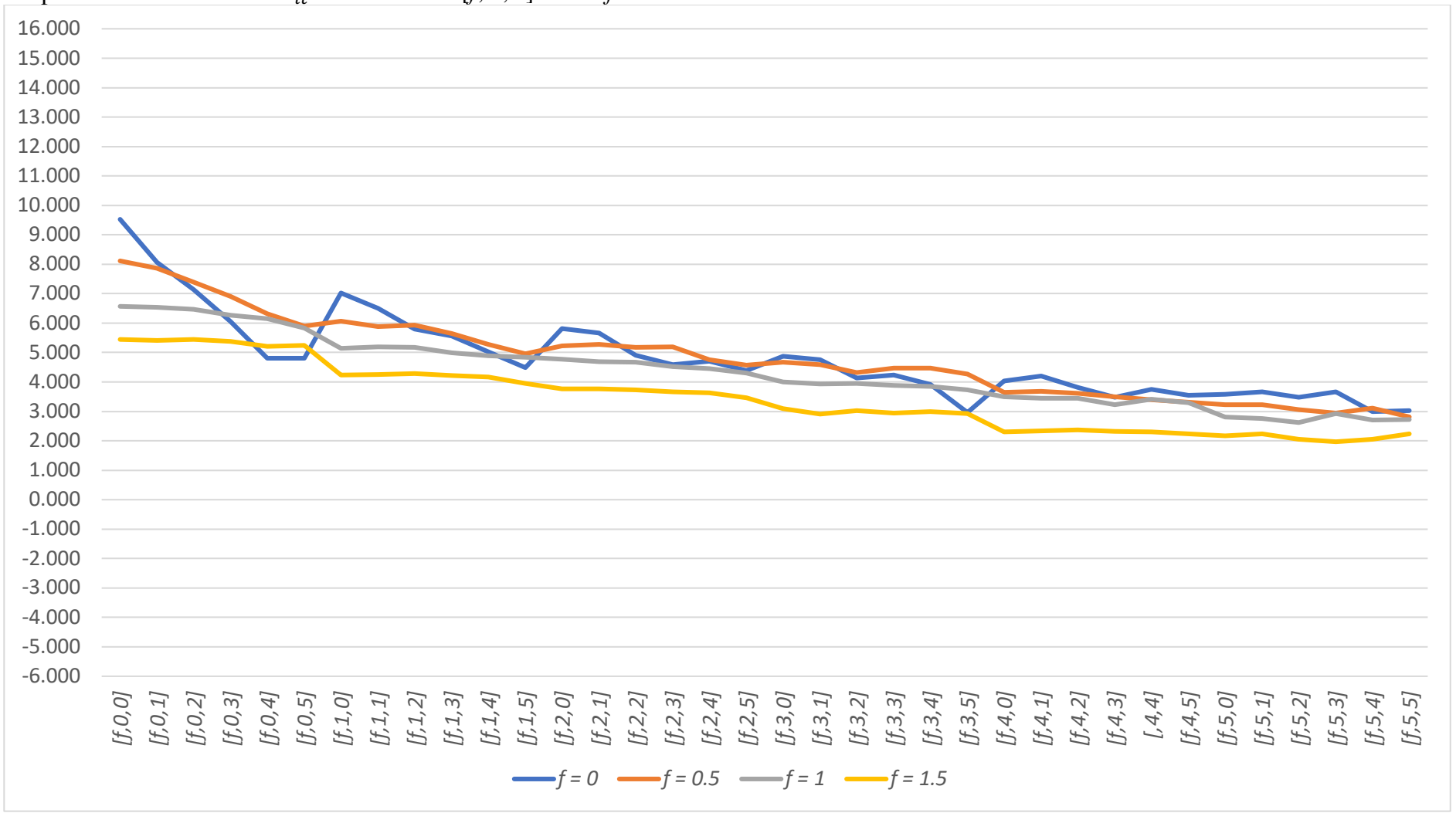
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.605*** | 5.878*** | 5.725*** | 4.765*** | 4.935*** | 4.421*** |
| 1 | 4.537*** | 4.565*** | 4.598*** | 4.488*** | 4.439*** | 4.271*** |
| 2 | 3.869*** | 3.911*** | 3.897*** | 3.821*** | 3.677*** | 3.592*** |
| 3 | 3.447*** | 3.381*** | 3.437*** | 3.261*** | 3.304*** | 3.142*** |
| 4 | 2.879*** | 2.912*** | 2.782*** | 2.795*** | 2.625*** | 2.542*** |
| 5 | 2.403*** | 2.470*** | 2.479*** | 2.223** | 2.322*** | 2.760*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.296*** | 5.134*** | 5.106*** | 4.839*** | 4.853*** | 4.435*** |
| 1 | 3.021*** | 3.050*** | 3.069*** | 3.126*** | 2.875*** | 2.824*** |
| 2 | 2.567*** | 2.658*** | 2.451*** | 2.434*** | 2.421*** | 2.330*** |
| 3 | 1.525* | 1.536* | 1.926** | 1.828** | 1.916** | 1.995** |
| 4 | 1.662* | 1.878** | 1.668* | 1.775** | 1.874** | 1.987** |
| 5 | 1.232 | 1.389 | 1.387 | 1.390 | 1.452* | 1.564* |

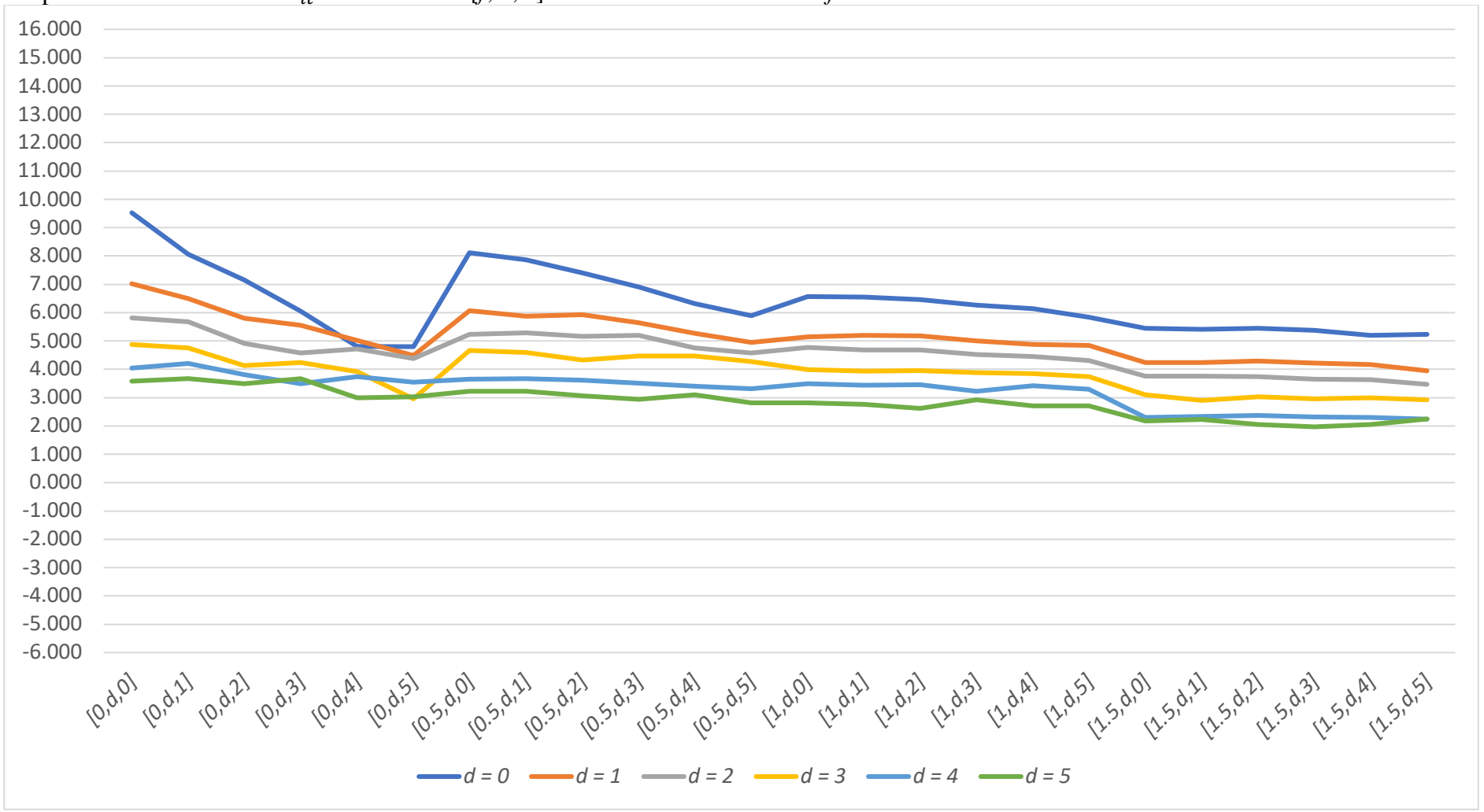
**Appendix 17: EW Developed S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



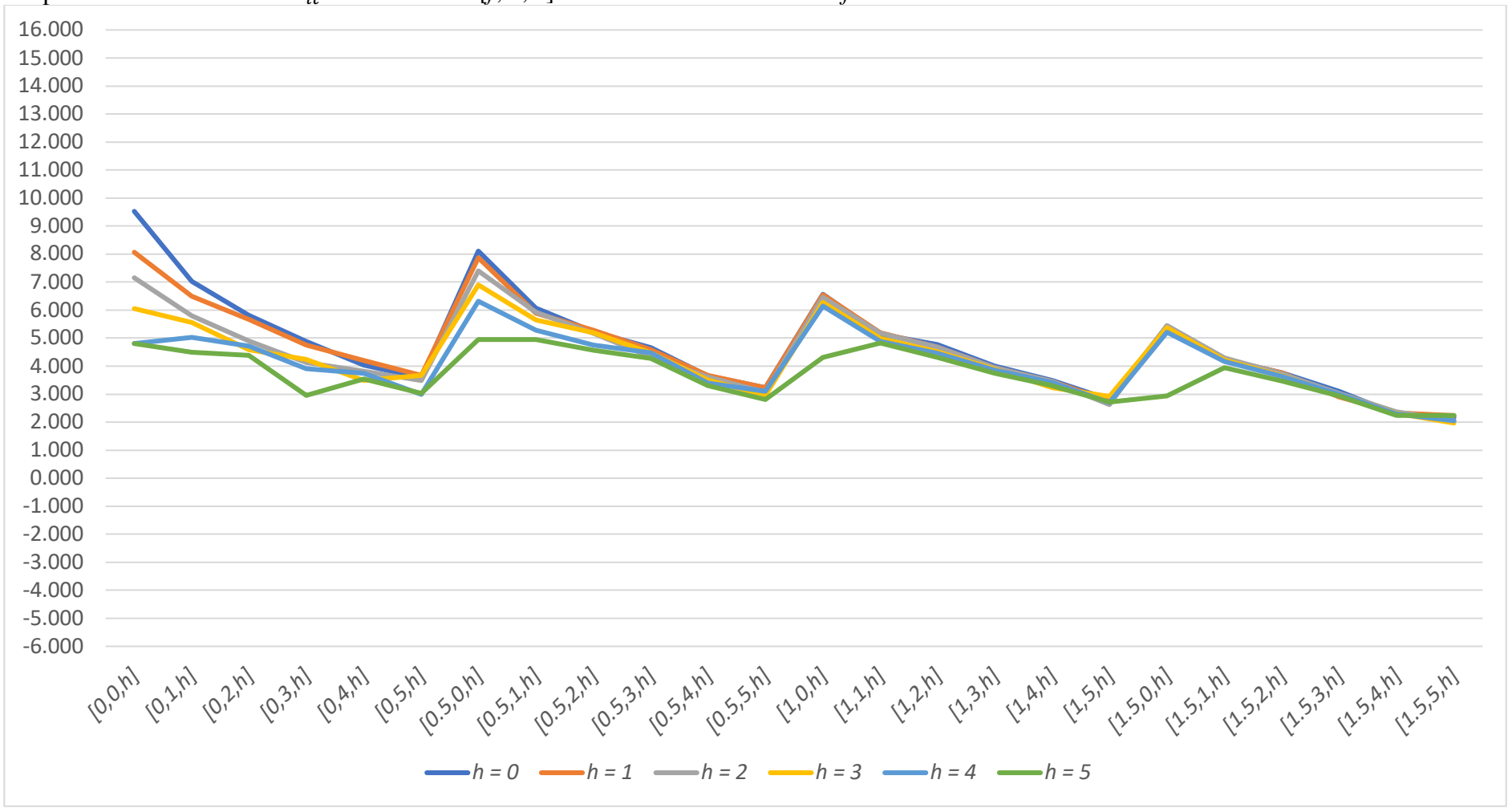
**Appendix 18: EW Developed S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 19: EW Developed S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 20: EW Developed S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.526*** | 8.065*** | 7.147*** | 6.048*** | 4.814*** | 4.799*** |
| 1 | 7.020*** | 6.502*** | 5.803*** | 5.556*** | 5.026*** | 4.487*** |
| 2 | 5.814*** | 5.669*** | 4.907*** | 4.581*** | 4.709*** | 4.382*** |
| 3 | 4.875*** | 4.749*** | 4.130*** | 4.233*** | 3.914*** | 2.963*** |
| 4 | 4.034*** | 4.205*** | 3.817*** | 3.487*** | 3.742*** | 3.551*** |
| 5 | 3.574*** | 3.671*** | 3.484*** | 3.664*** | 2.991*** | 3.027*** |

***f = 0.5***

| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.113*** | 7.863*** | 7.400*** | 6.899*** | 6.317*** | 5.892*** |
| 1 | 6.072*** | 5.880*** | 5.928*** | 5.646*** | 5.275*** | 4.950*** |
| 2 | 5.233*** | 5.280*** | 5.168*** | 5.191*** | 4.749*** | 4.570*** |
| 3 | 4.665*** | 4.592*** | 4.326*** | 4.468*** | 4.474*** | 4.275*** |
| 4 | 3.648*** | 3.677*** | 3.613*** | 3.500*** | 3.399*** | 3.309*** |
| 5 | 3.232*** | 3.228*** | 3.060*** | 2.948** | 3.105*** | 2.814** |

***f = 1***

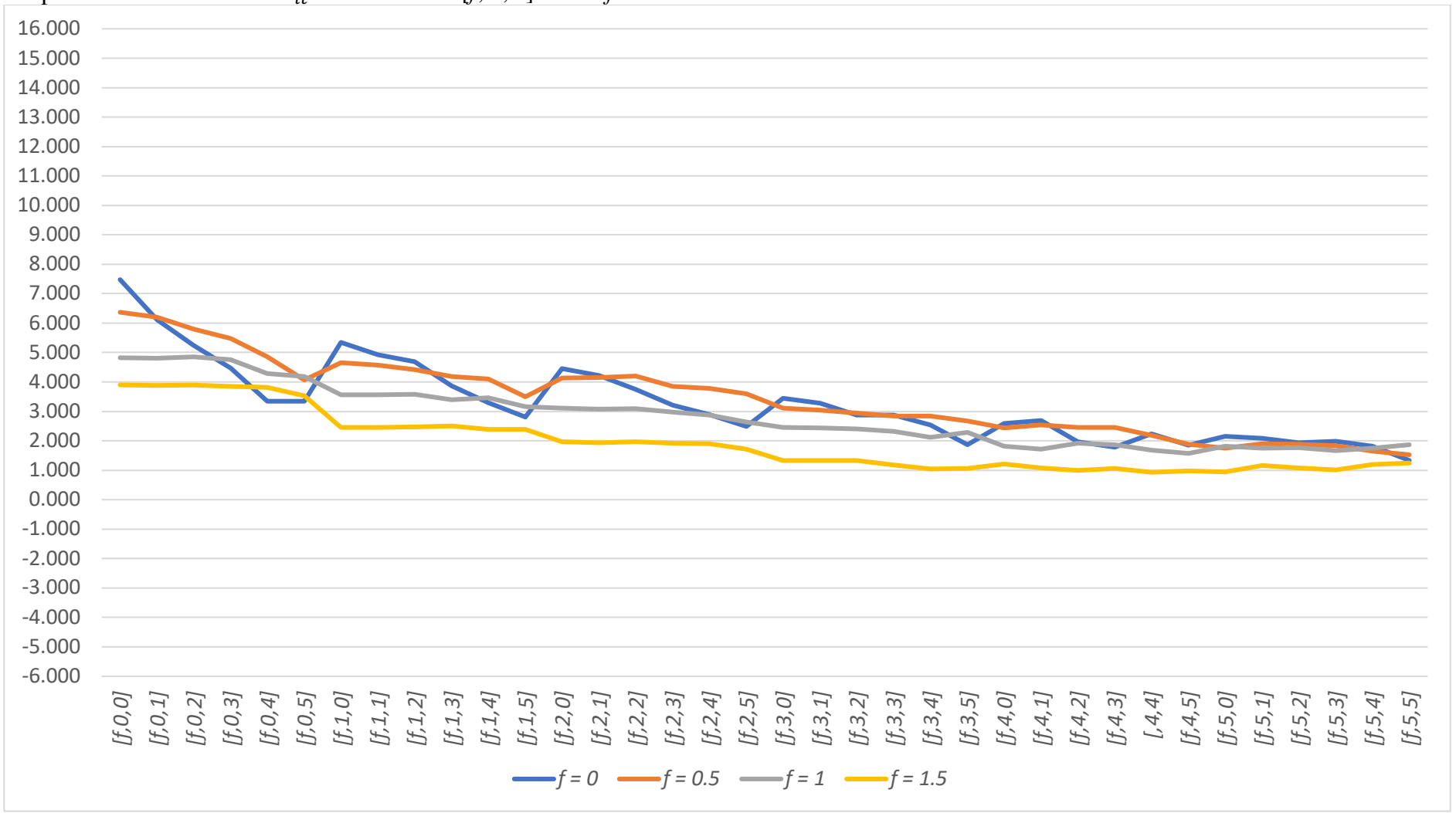
| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.569*** | 7.020*** | 6.502*** | 5.803*** | 5.556*** | 5.026*** |
| 1 | 5.143*** | 5.193*** | 5.176*** | 4.998*** | 4.885*** | 4.834*** |
| 2 | 4.775*** | 4.682*** | 4.680*** | 4.516*** | 4.451*** | 4.308*** |
| 3 | 3.996*** | 3.938*** | 3.947*** | 3.889*** | 3.855*** | 3.738*** |
| 4 | 3.489*** | 3.442*** | 3.450*** | 3.231*** | 3.416*** | 3.296*** |
| 5 | 2.815** | 2.757** | 2.621** | 2.918** | 2.707** | 2.717** |

***f = 1.5***

| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.438*** | 6.072*** | 5.880*** | 5.928*** | 5.646*** | 5.275*** |
| 1 | 4.240*** | 4.244*** | 4.293*** | 4.220*** | 4.164*** | 3.947*** |
| 2 | 3.764*** | 3.764*** | 3.731*** | 3.659*** | 3.635*** | 3.468*** |
| 3 | 3.094*** | 2.901** | 3.025** | 2.950** | 2.995** | 2.929** |
| 4 | 2.299** | 2.338** | 2.372** | 2.314** | 2.304** | 2.240* |
| 5 | 2.169* | 2.236* | 2.059* | 1.969* | 2.050* | 2.239* |

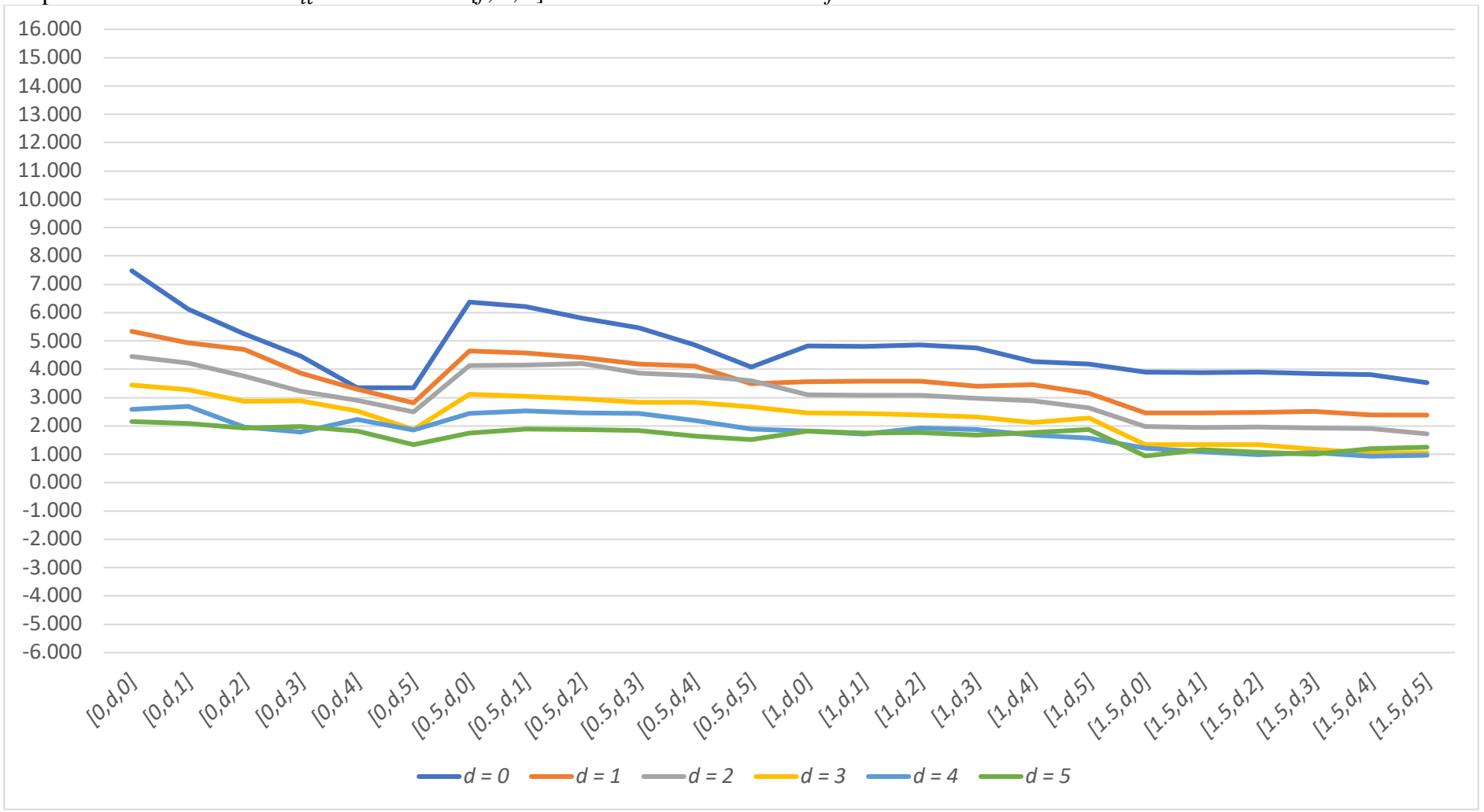
**Appendix 21: EW Developed S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



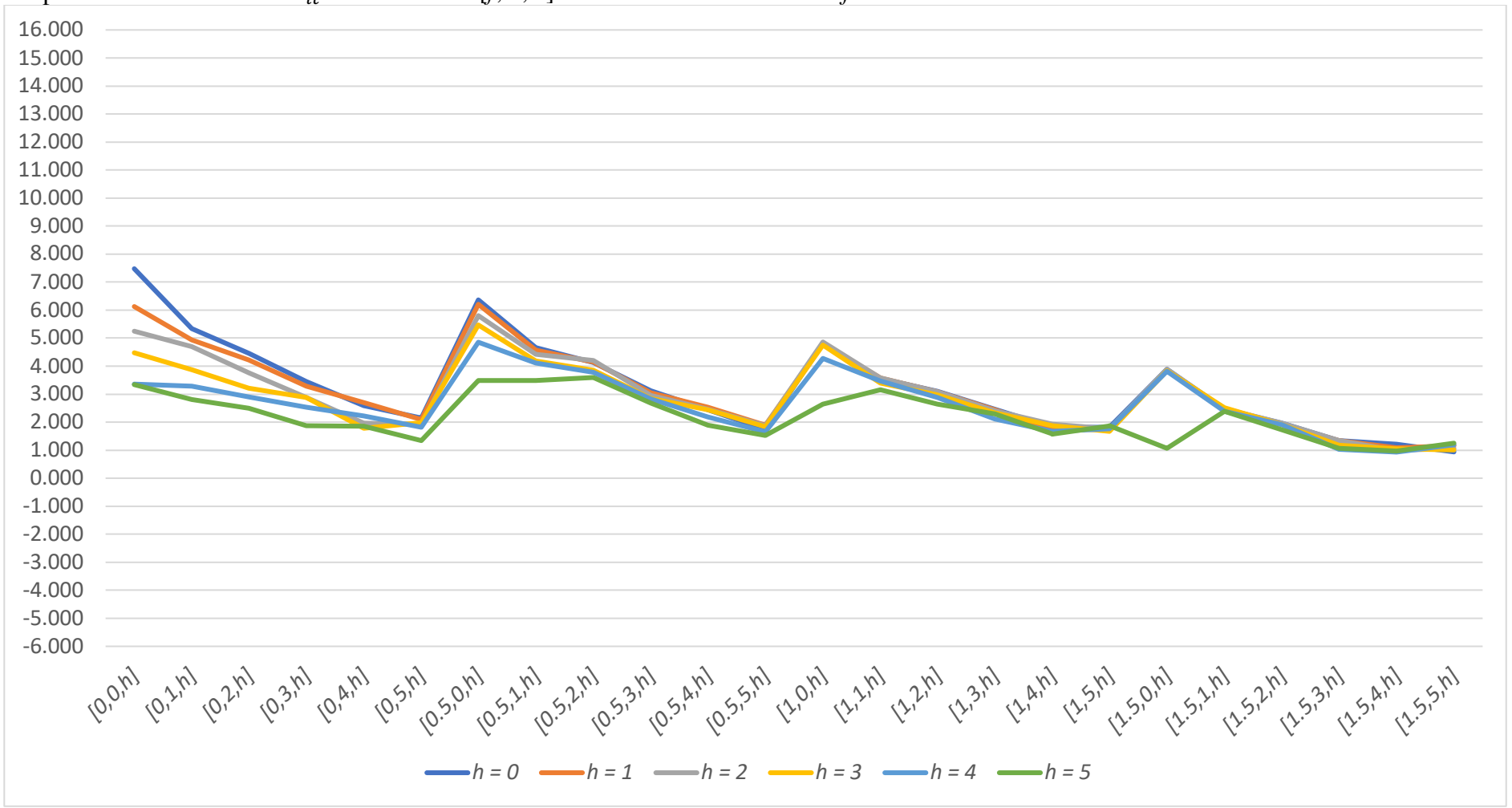
**Appendix 22: EW Developed S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 23: EW Developed S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 24: EW Developed S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.477*** | 6.121*** | 5.250*** | 4.477*** | 3.351*** | 3.346*** |
| 1 | 5.339*** | 4.932*** | 4.696*** | 3.866*** | 3.292*** | 2.816*** |
| 2 | 4.453*** | 4.219*** | 3.756*** | 3.217*** | 2.896*** | 2.490** |
| 3 | 3.444*** | 3.282*** | 2.876*** | 2.878*** | 2.539** | 1.873* |
| 4 | 2.582** | 2.692*** | 1.962* | 1.786* | 2.231** | 1.853* |
| 5 | 2.155** | 2.091** | 1.928* | 1.977* | 1.813* | 1.335 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.368*** | 6.208*** | 5.803*** | 5.470*** | 4.854*** | 4.073*** |
| 1 | 4.655*** | 4.570*** | 4.422*** | 4.182*** | 4.107*** | 3.489*** |
| 2 | 4.127*** | 4.144*** | 4.203*** | 3.857*** | 3.779*** | 3.595*** |
| 3 | 3.117*** | 3.041*** | 2.950*** | 2.840*** | 2.836*** | 2.679** |
| 4 | 2.441** | 2.534** | 2.461** | 2.449** | 2.191** | 1.889* |
| 5 | 1.750 | 1.894* | 1.877* | 1.831* | 1.645 | 1.526 |

***f = 1***

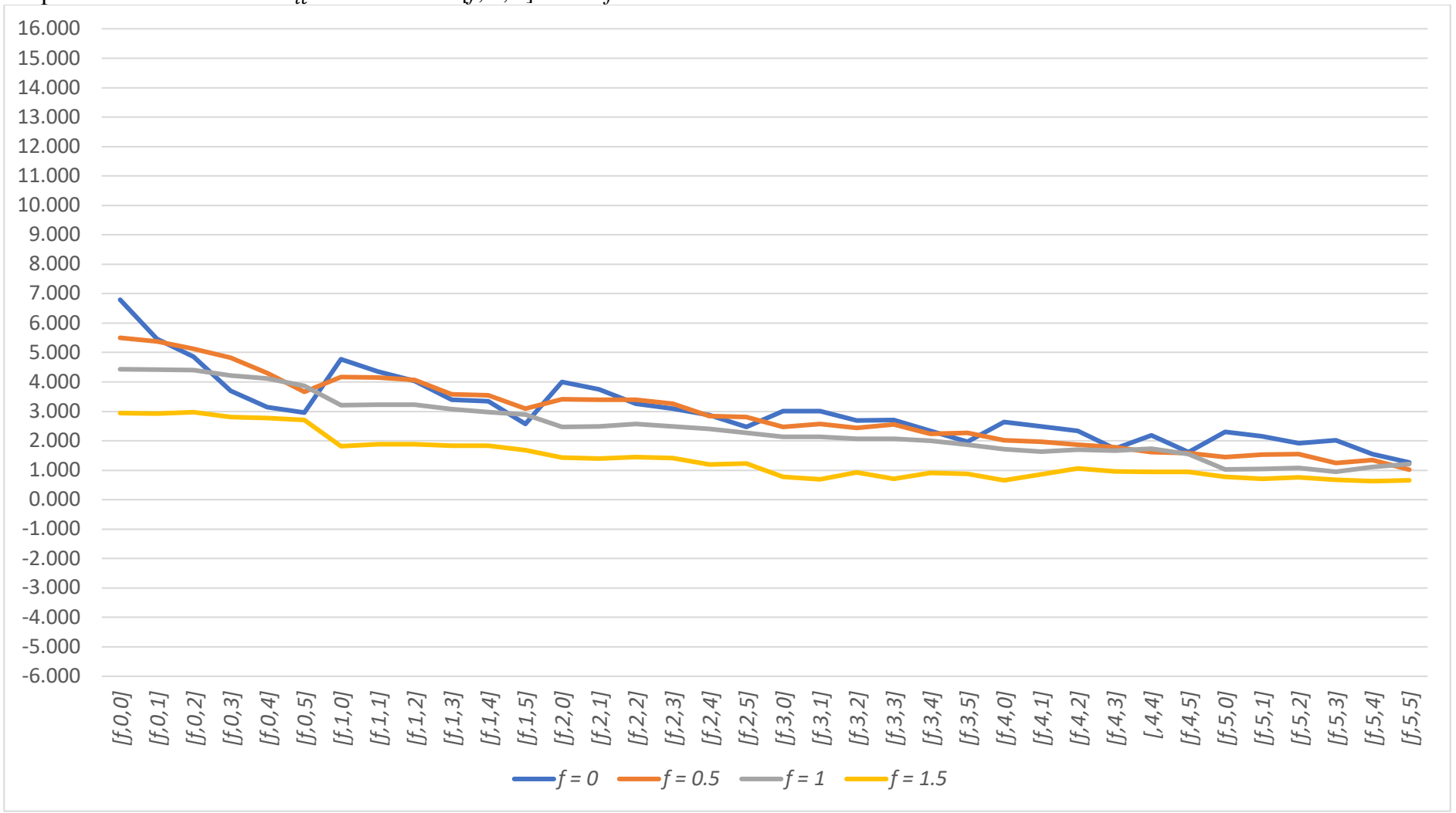
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.826*** | 5.339*** | 4.932*** | 4.696*** | 3.866*** | 3.292*** |
| 1 | 3.566*** | 3.571*** | 3.576*** | 3.396*** | 3.461*** | 3.154*** |
| 2 | 3.106*** | 3.083*** | 3.090*** | 2.975*** | 2.878*** | 2.641** |
| 3 | 2.457** | 2.445** | 2.397** | 2.326** | 2.121** | 2.287** |
| 4 | 1.820* | 1.719 | 1.924* | 1.873* | 1.675 | 1.573 |
| 5 | 1.818* | 1.746 | 1.765 | 1.674 | 1.758 | 1.866* |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.892*** | 4.655*** | 4.570*** | 4.422*** | 4.182*** | 4.107*** |
| 1 | 2.462** | 2.458** | 2.478** | 2.511** | 2.386** | 2.384** |
| 2 | 1.972* | 1.937* | 1.969* | 1.918* | 1.904* | 1.720 |
| 3 | 1.334 | 1.334 | 1.337 | 1.173 | 1.038 | 1.060 |
| 4 | 1.218 | 1.086 | 0.990 | 1.058 | 0.932 | 0.970 |
| 5 | 0.939 | 1.154 | 1.075 | 1.009 | 1.200 | 1.242 |

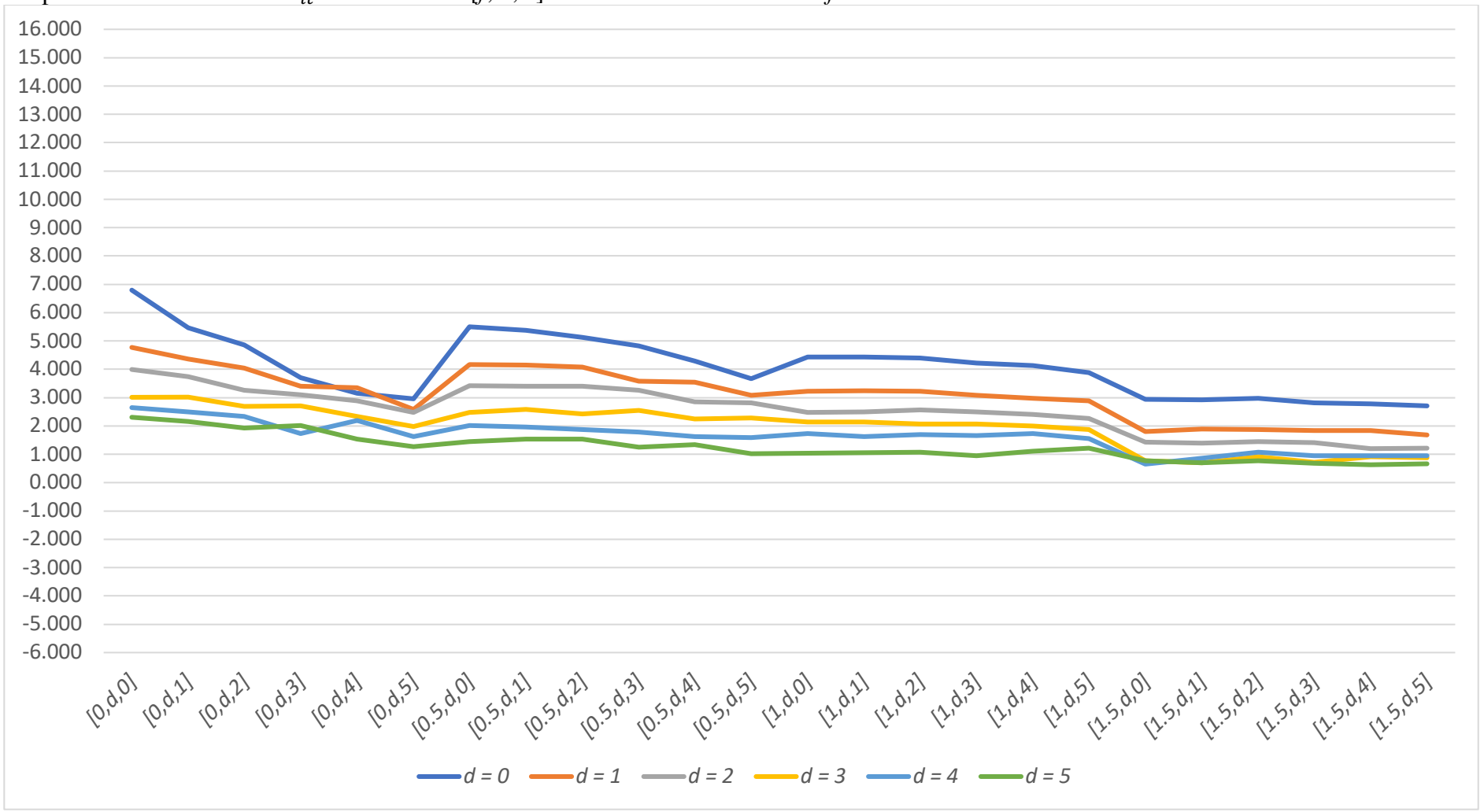
**Appendix 25: EW Developed S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



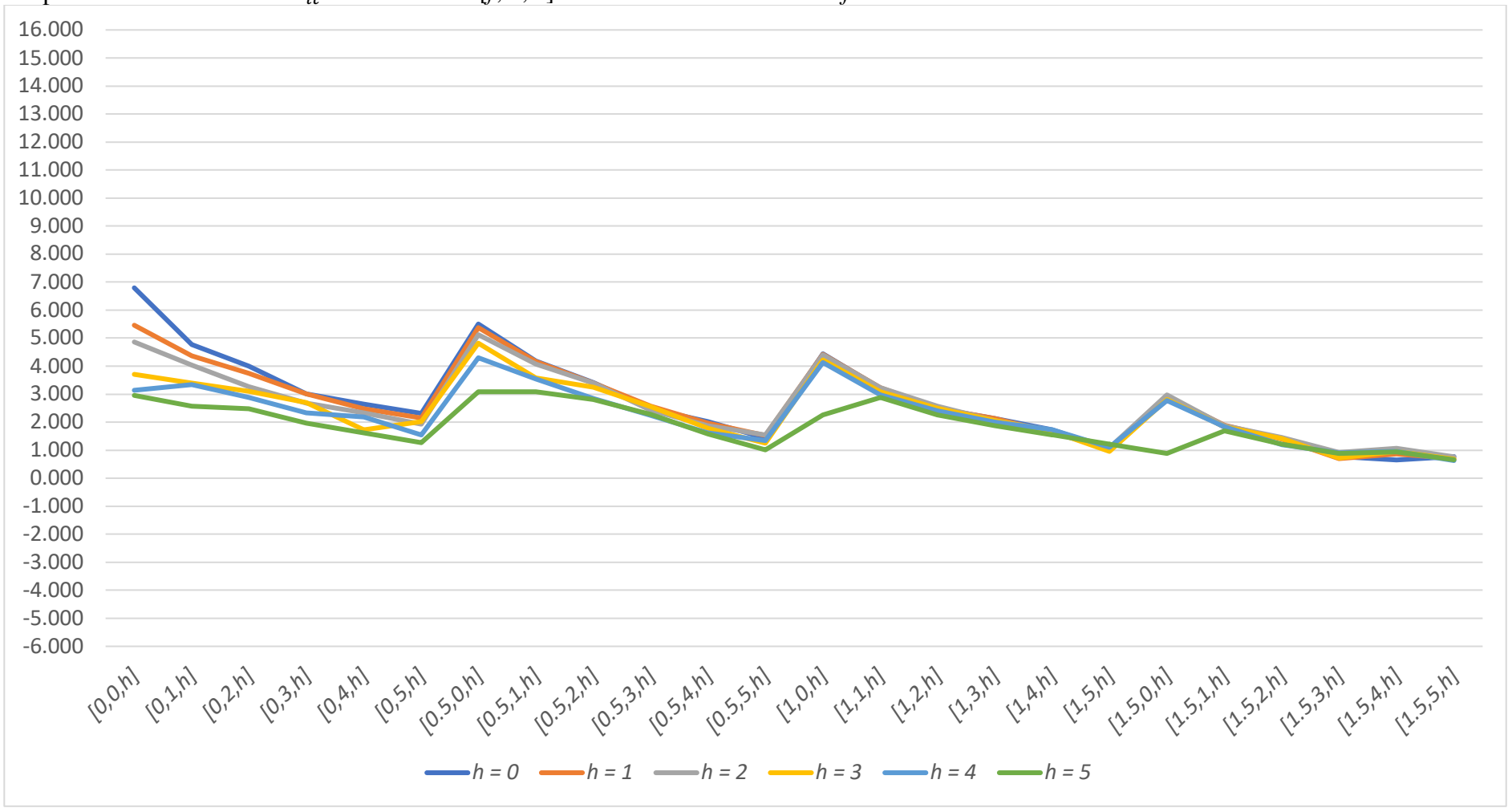
**Appendix 26: EW Developed S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 27: EW Developed S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 28: EW Developed S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.795*** | 5.460*** | 4.859*** | 3.699*** | 3.148*** | 2.962*** |
| 1 | 4.772*** | 4.360*** | 4.035*** | 3.395*** | 3.349*** | 2.579*** |
| 2 | 3.993*** | 3.748*** | 3.259*** | 3.099*** | 2.879*** | 2.477*** |
| 3 | 3.011*** | 3.017*** | 2.689*** | 2.701*** | 2.335** | 1.974** |
| 4 | 2.647*** | 2.488*** | 2.335** | 1.731* | 2.188** | 1.616* |
| 5 | 2.306** | 2.157** | 1.923** | 2.015** | 1.543 | 1.265 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.500*** | 5.377*** | 5.123*** | 4.819*** | 4.299*** | 3.669*** |
| 1 | 4.175*** | 4.157*** | 4.074*** | 3.581*** | 3.548*** | 3.086*** |
| 2 | 3.414*** | 3.398*** | 3.397*** | 3.256*** | 2.845*** | 2.810*** |
| 3 | 2.479** | 2.578*** | 2.431** | 2.556*** | 2.240** | 2.274** |
| 4 | 2.020** | 1.969** | 1.866* | 1.776* | 1.620 | 1.580 |
| 5 | 1.443 | 1.531 | 1.541 | 1.248 | 1.347 | 1.020 |

***f = 1***

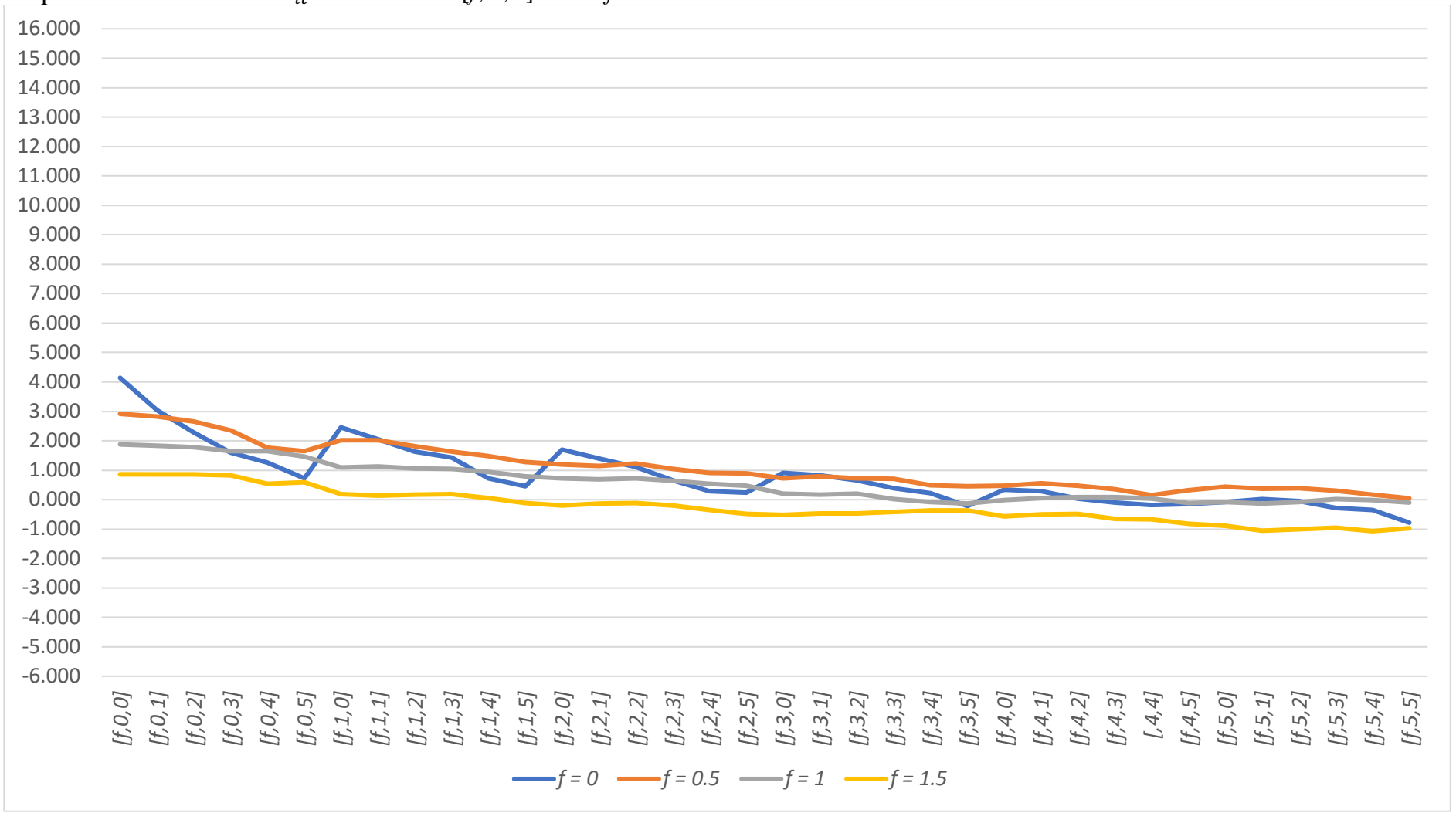
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.432*** | 4.772*** | 4.360*** | 4.035*** | 3.395*** | 3.349*** |
| 1 | 3.218*** | 3.236*** | 3.224*** | 3.083*** | 2.970*** | 2.890*** |
| 2 | 2.474** | 2.492** | 2.566*** | 2.491** | 2.404** | 2.265** |
| 3 | 2.134** | 2.139** | 2.064** | 2.062** | 2.004** | 1.872* |
| 4 | 1.723* | 1.628* | 1.700* | 1.664* | 1.726* | 1.550 |
| 5 | 1.030 | 1.051 | 1.079 | 0.949 | 1.107 | 1.214 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.945*** | 4.175*** | 4.157*** | 4.074*** | 3.581*** | 3.548*** |
| 1 | 1.810* | 1.887** | 1.881** | 1.831* | 1.832* | 1.682* |
| 2 | 1.431 | 1.400 | 1.444 | 1.410 | 1.199 | 1.222 |
| 3 | 0.776 | 0.699 | 0.919 | 0.713 | 0.907 | 0.880 |
| 4 | 0.652 | 0.857 | 1.065 | 0.955 | 0.951 | 0.948 |
| 5 | 0.770 | 0.706 | 0.765 | 0.680 | 0.630 | 0.658 |

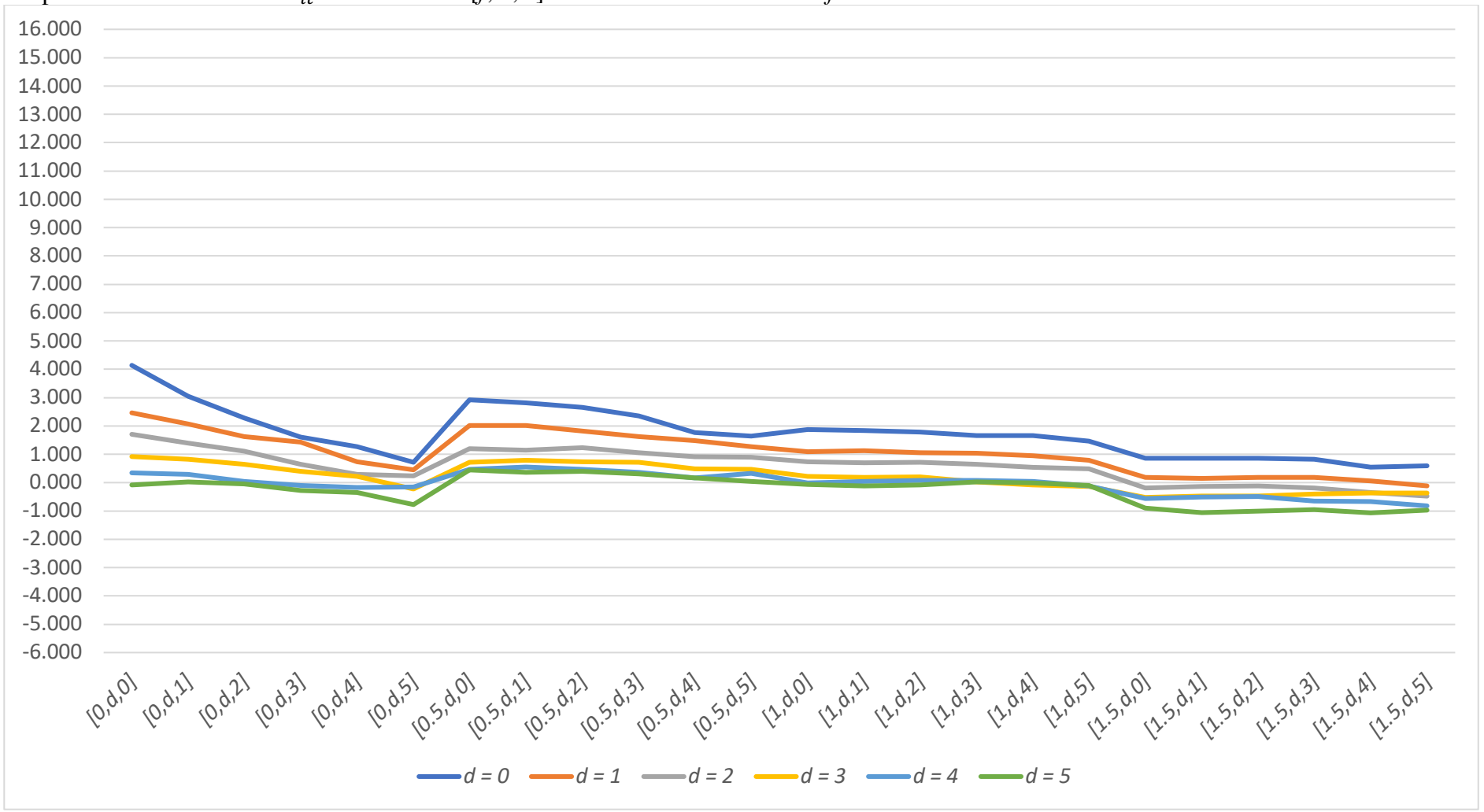
**Appendix 29: EW Developed S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



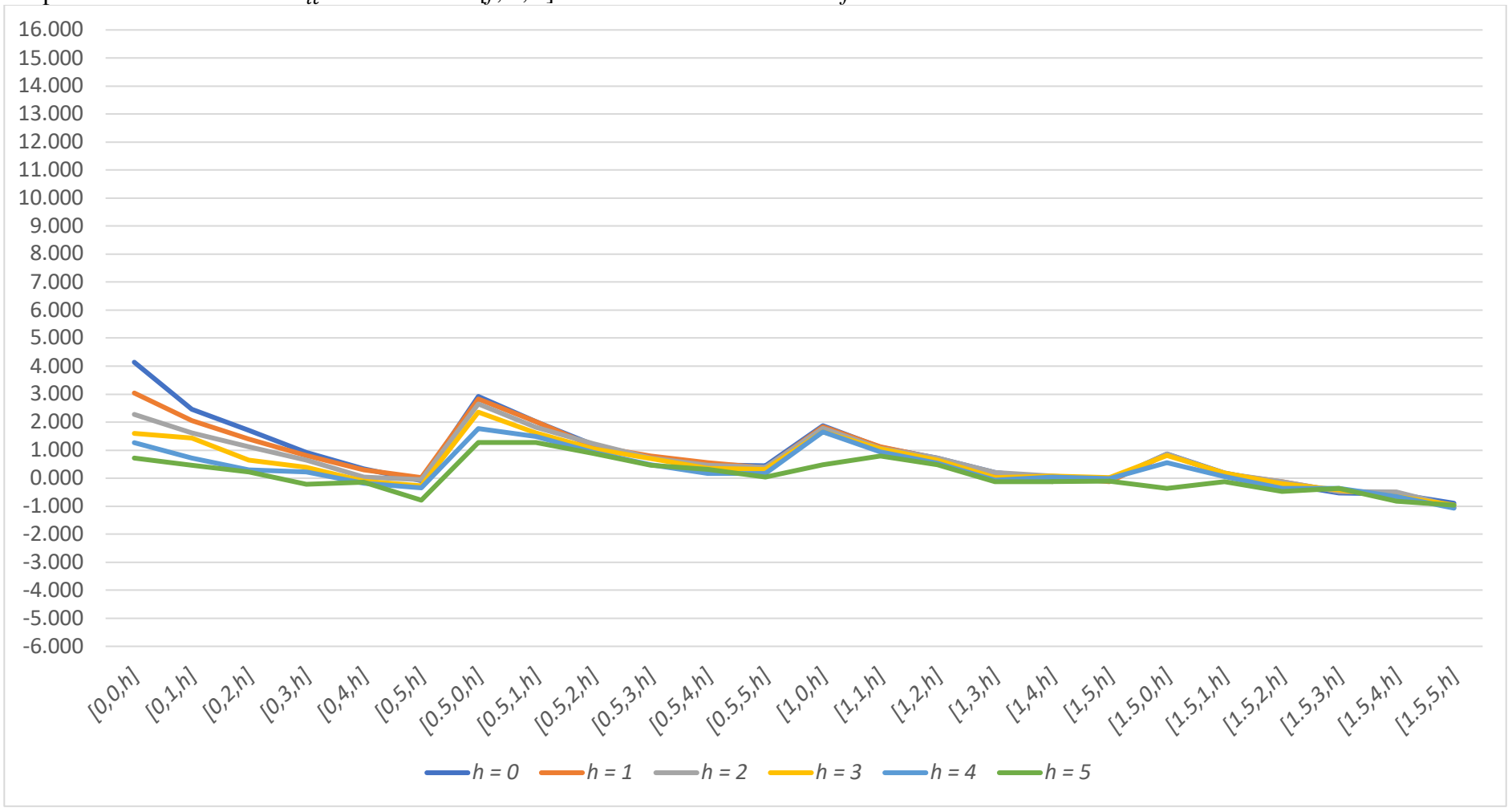
**Appendix 30: EW Developed S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 31: EW Developed S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 32: EW Developed S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.140*** | 3.041*** | 2.285*** | 1.601** | 1.266 | 0.722 |
| 1 | 2.463*** | 2.060** | 1.625** | 1.432* | 0.727 | 0.458 |
| 2 | 1.705** | 1.390* | 1.114 | 0.653 | 0.293 | 0.231 |
| 3 | 0.918 | 0.818 | 0.652 | 0.390 | 0.221 | -0.223 |
| 4 | 0.343 | 0.293 | 0.037 | -0.101 | -0.178 | -0.148 |
| 5 | -0.087 | 0.020 | -0.052 | -0.275 | -0.346 | -0.781 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.916*** | 2.823*** | 2.651*** | 2.358*** | 1.771** | 1.647** |
| 1 | 2.014** | 2.015** | 1.817** | 1.624** | 1.480* | 1.275 |
| 2 | 1.190 | 1.143 | 1.230 | 1.048 | 0.914 | 0.889 |
| 3 | 0.726 | 0.788 | 0.728 | 0.709 | 0.484 | 0.461 |
| 4 | 0.475 | 0.551 | 0.467 | 0.360 | 0.162 | 0.320 |
| 5 | 0.446 | 0.365 | 0.396 | 0.314 | 0.171 | 0.046 |

***f = 1***

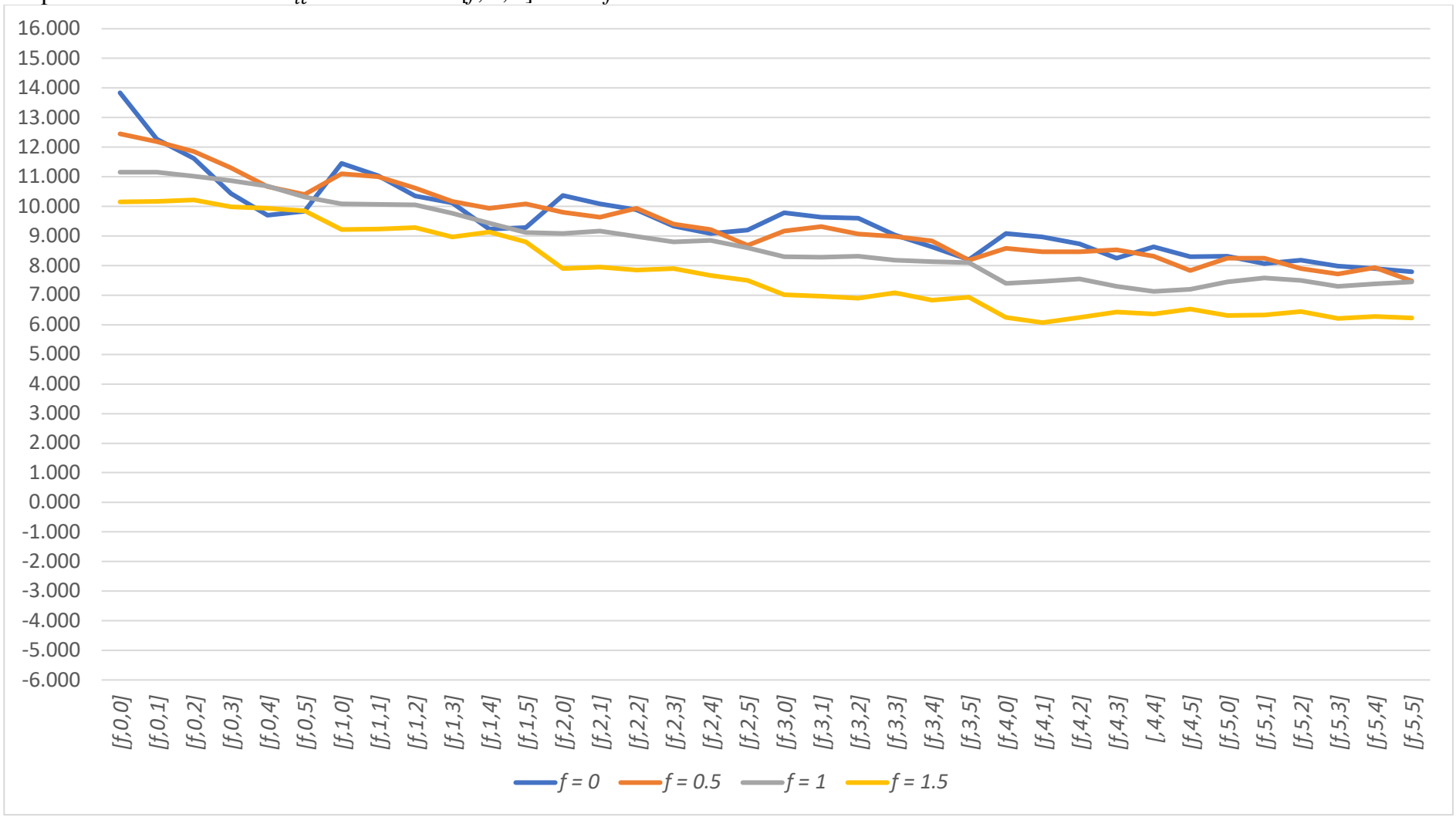
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 1.878** | 2.463*** | 2.060** | 1.625** | 1.432* | 0.727 |
| 1 | 1.097 | 1.131 | 1.061 | 1.046 | 0.946 | 0.787 |
| 2 | 0.727 | 0.693 | 0.720 | 0.639 | 0.539 | 0.482 |
| 3 | 0.211 | 0.176 | 0.208 | 0.017 | -0.075 | -0.130 |
| 4 | -0.011 | 0.050 | 0.085 | 0.086 | 0.042 | -0.120 |
| 5 | -0.073 | -0.126 | -0.077 | 0.019 | -0.018 | -0.104 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0.862 | 2.014** | 2.015** | 1.817** | 1.624** | 1.480* |
| 1 | 0.191 | 0.143 | 0.177 | 0.184 | 0.058 | -0.116 |
| 2 | -0.191 | -0.132 | -0.122 | -0.195 | -0.354 | -0.478 |
| 3 | -0.523 | -0.470 | -0.467 | -0.411 | -0.363 | -0.366 |
| 4 | -0.565 | -0.503 | -0.490 | -0.652 | -0.665 | -0.821 |
| 5 | -0.892 | -1.054 | -1.007 | -0.956 | -1.069 | -0.963 |

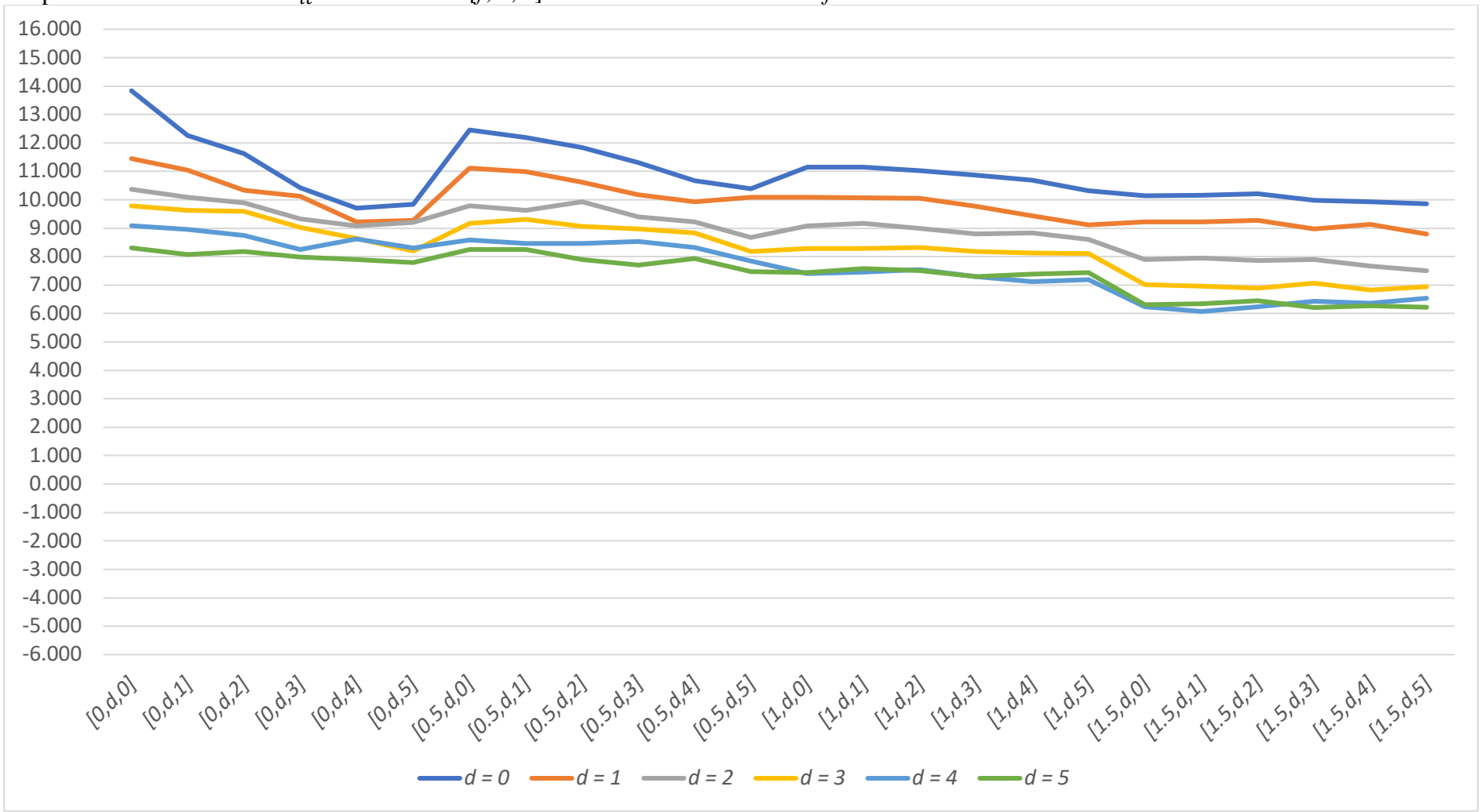
**Appendix 33: VW Developed excl. US S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



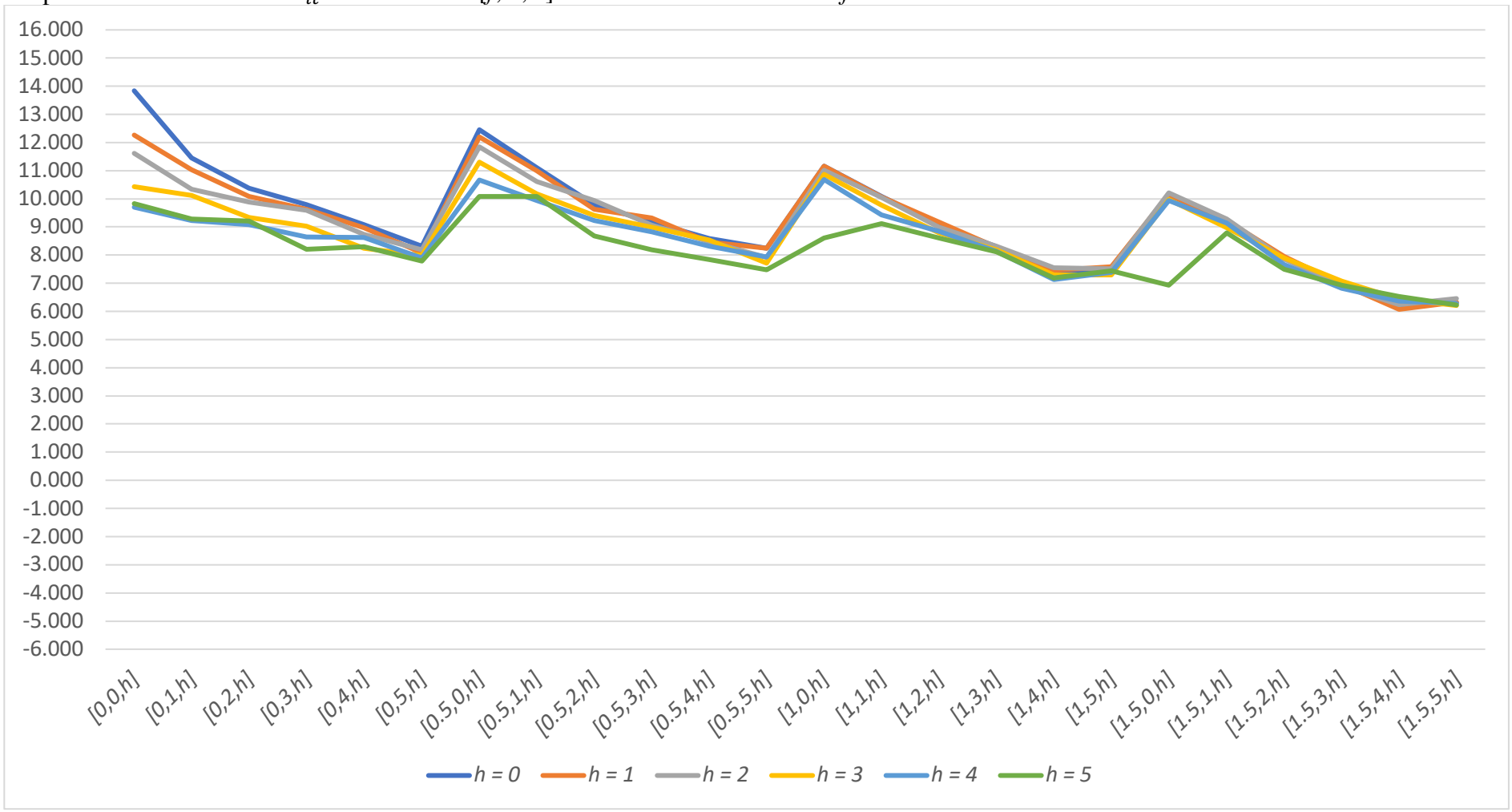
**Appendix 34: VW Developed excl. US S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 35: VW Developed excl. US S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 36: VW Developed excl. US S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.837*** | 12.264*** | 11.620*** | 10.430*** | 9.708*** | 9.835*** |
| 1 | 11.449*** | 11.040*** | 10.345*** | 10.118*** | 9.226*** | 9.281*** |
| 2 | 10.369*** | 10.087*** | 9.890*** | 9.338*** | 9.086*** | 9.203*** |
| 3 | 9.786*** | 9.632*** | 9.596*** | 9.025*** | 8.635*** | 8.207*** |
| 4 | 9.089*** | 8.967*** | 8.740*** | 8.248*** | 8.627*** | 8.303*** |
| 5 | 8.309*** | 8.071*** | 8.183*** | 7.987*** | 7.897*** | 7.791*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.450*** | 12.190*** | 11.845*** | 11.302*** | 10.670*** | 10.395*** |
| 1 | 11.110*** | 10.999*** | 10.621*** | 10.175*** | 9.937*** | 10.083*** |
| 2 | 9.795*** | 9.627*** | 9.937*** | 9.403*** | 9.223*** | 8.675*** |
| 3 | 9.166*** | 9.314*** | 9.072*** | 8.983*** | 8.829*** | 8.190*** |
| 4 | 8.591*** | 8.469*** | 8.471*** | 8.537*** | 8.322*** | 7.837*** |
| 5 | 8.249*** | 8.252*** | 7.907*** | 7.708*** | 7.927*** | 7.480*** |

***f = 1***

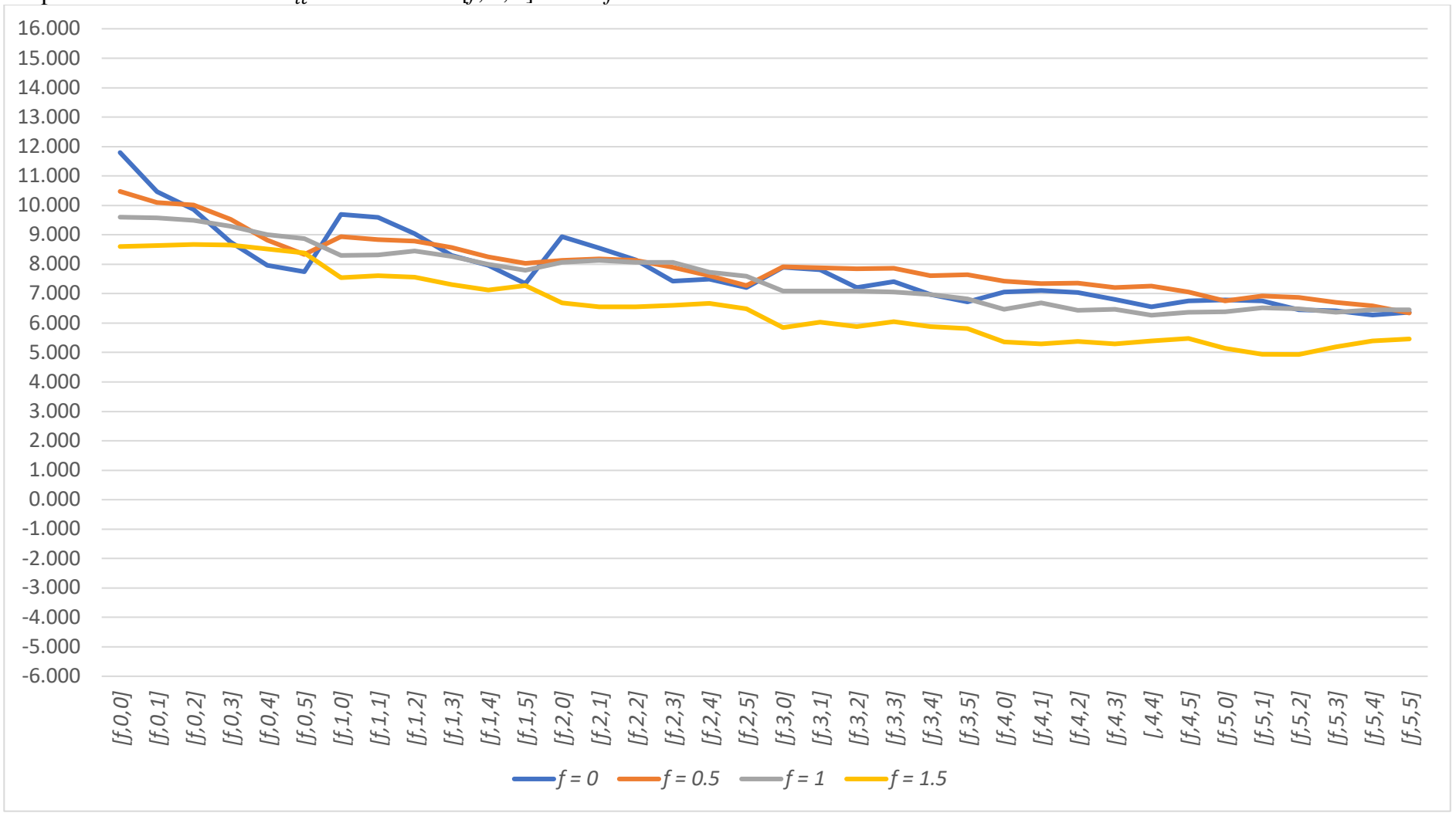
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.155*** | 11.449*** | 11.040*** | 10.345*** | 10.118*** | 9.226*** |
| 1 | 10.084*** | 10.072*** | 10.051*** | 9.771*** | 9.432*** | 9.112*** |
| 2 | 9.075*** | 9.166*** | 8.990*** | 8.793*** | 8.842*** | 8.600*** |
| 3 | 8.294*** | 8.286*** | 8.321*** | 8.181*** | 8.133*** | 8.107*** |
| 4 | 7.405*** | 7.461*** | 7.549*** | 7.304*** | 7.127*** | 7.190*** |
| 5 | 7.441*** | 7.580*** | 7.506*** | 7.304*** | 7.380*** | 7.442*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.146*** | 11.110*** | 10.999*** | 10.621*** | 10.175*** | 9.937*** |
| 1 | 9.220*** | 9.228*** | 9.284*** | 8.971*** | 9.130*** | 8.795*** |
| 2 | 7.905*** | 7.945*** | 7.855*** | 7.900*** | 7.665*** | 7.504*** |
| 3 | 7.015*** | 6.965*** | 6.892*** | 7.074*** | 6.826*** | 6.937*** |
| 4 | 6.239*** | 6.072*** | 6.239*** | 6.434*** | 6.363*** | 6.536*** |
| 5 | 6.313*** | 6.336*** | 6.448*** | 6.210*** | 6.281*** | 6.228*** |

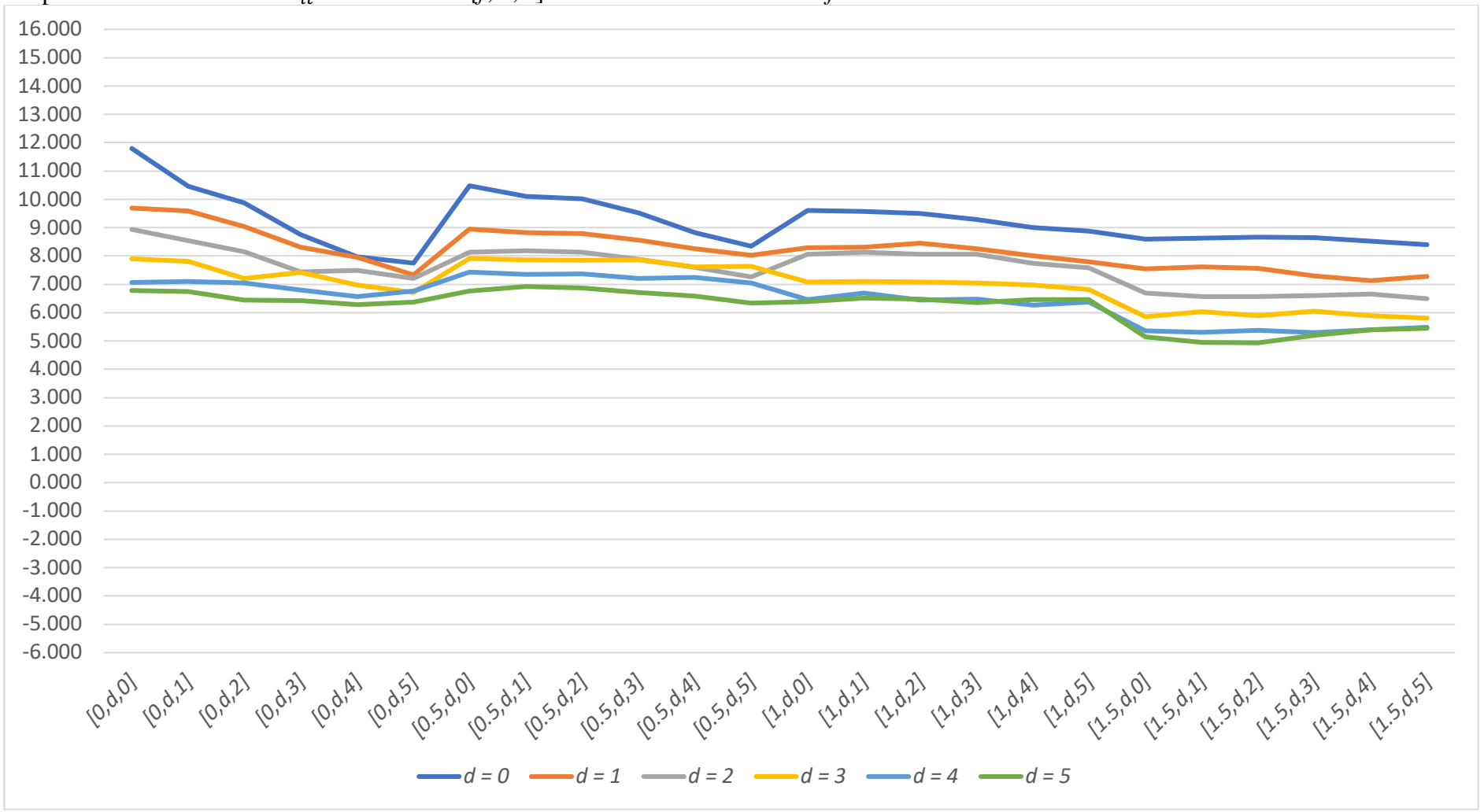
**Appendix 37: VW Developed excl. US S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



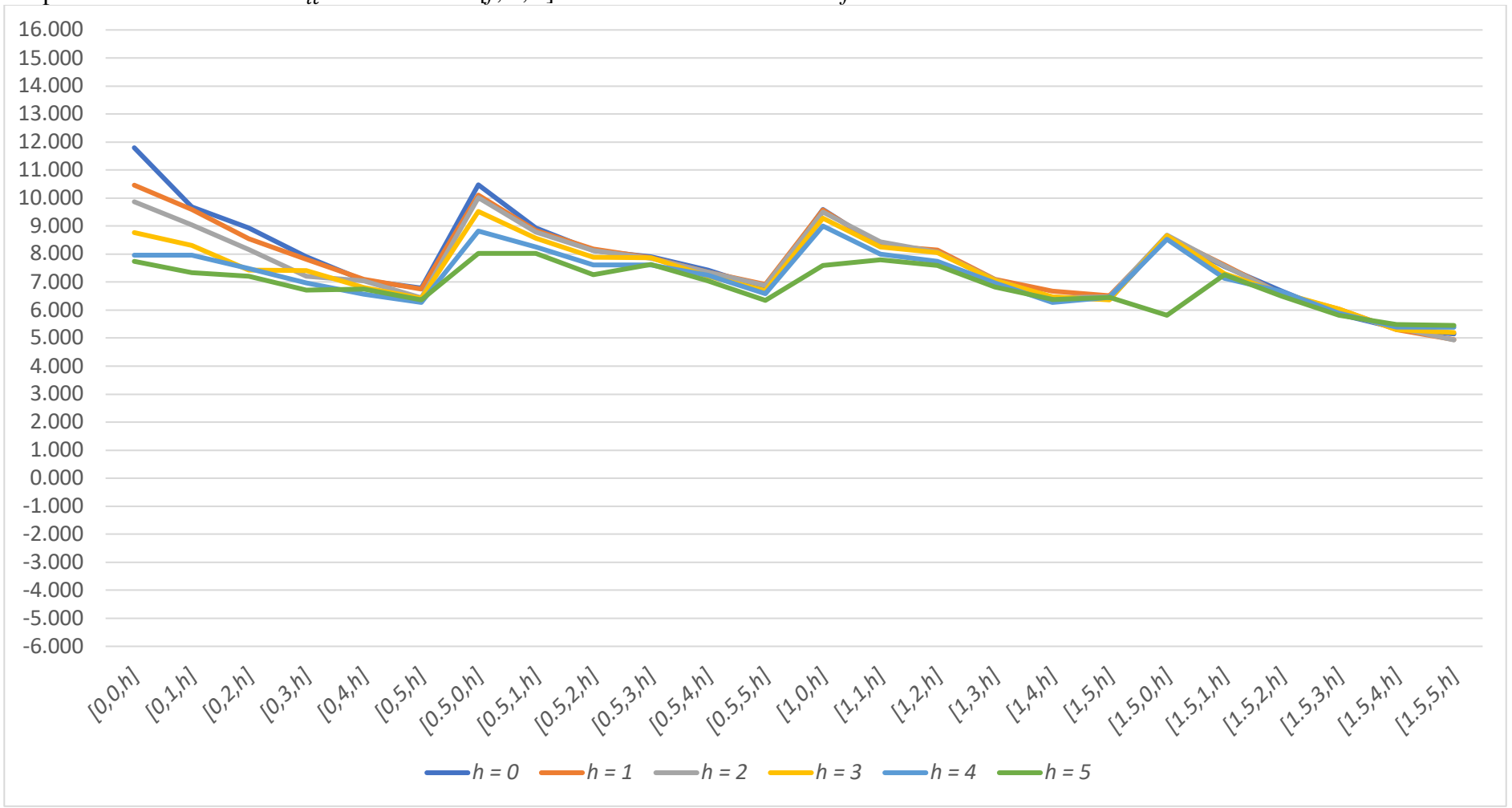
**Appendix 38: VW Developed excl. US S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 39: VW Developed excl. US S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 40: VW Developed excl. US S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.795*** | 10.459*** | 9.866*** | 8.758*** | 7.965*** | 7.748*** |
| 1 | 9.691*** | 9.597*** | 9.043*** | 8.302*** | 7.961*** | 7.335*** |
| 2 | 8.936*** | 8.546*** | 8.156*** | 7.430*** | 7.490*** | 7.213*** |
| 3 | 7.898*** | 7.811*** | 7.205*** | 7.413*** | 6.971*** | 6.716*** |
| 4 | 7.063*** | 7.100*** | 7.046*** | 6.802*** | 6.560*** | 6.757*** |
| 5 | 6.783*** | 6.751*** | 6.446*** | 6.417*** | 6.274*** | 6.364*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.474*** | 10.104*** | 10.013*** | 9.521*** | 8.823*** | 8.338*** |
| 1 | 8.941*** | 8.833*** | 8.786*** | 8.562*** | 8.256*** | 8.024*** |
| 2 | 8.132*** | 8.177*** | 8.130*** | 7.890*** | 7.605*** | 7.268*** |
| 3 | 7.913*** | 7.872*** | 7.844*** | 7.863*** | 7.613*** | 7.637*** |
| 4 | 7.431*** | 7.348*** | 7.363*** | 7.203*** | 7.251*** | 7.051*** |
| 5 | 6.762*** | 6.922*** | 6.875*** | 6.702*** | 6.591*** | 6.343*** |

***f = 1***

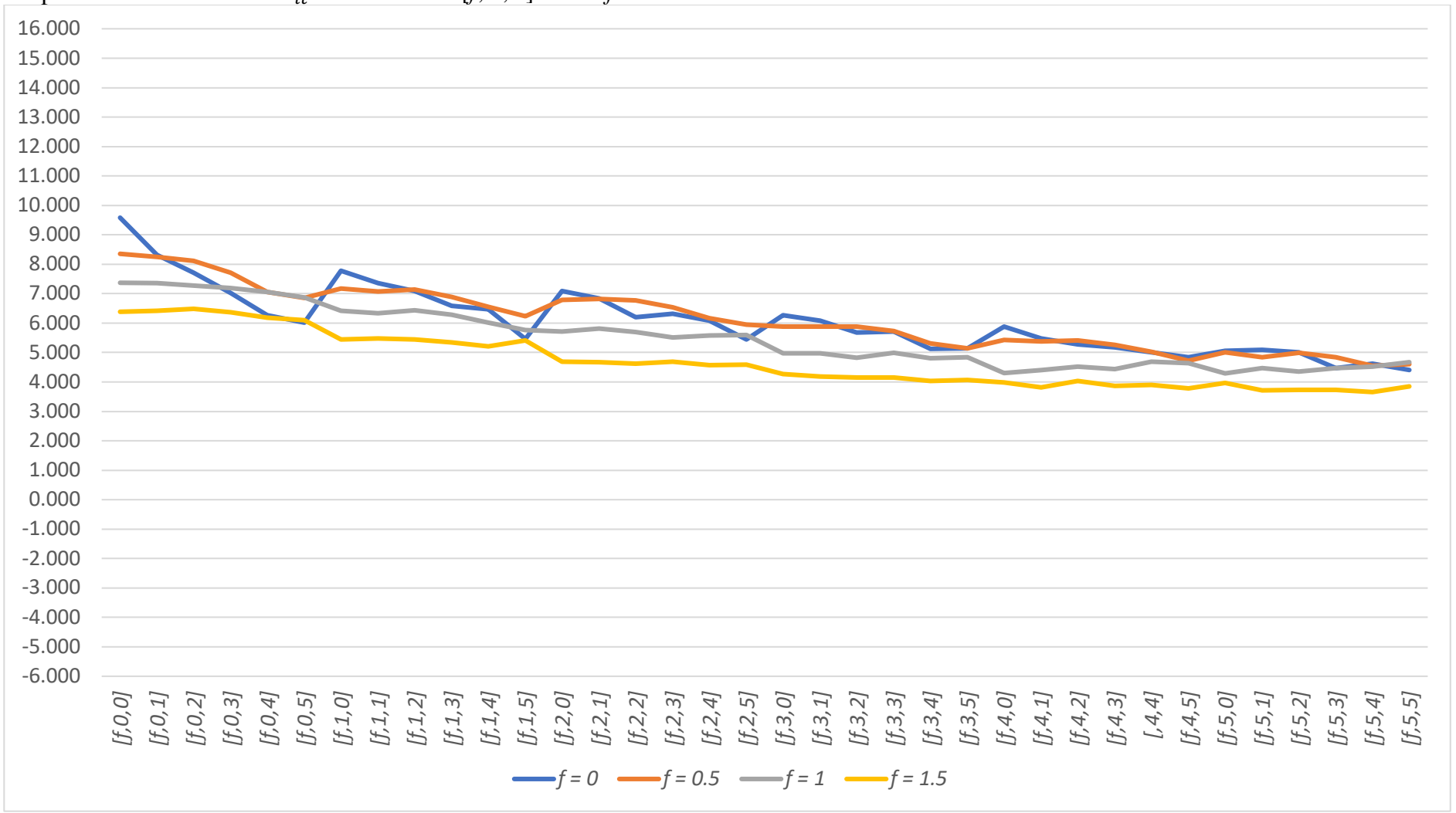
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.600*** | 9.691*** | 9.597*** | 9.043*** | 8.302*** | 7.961*** |
| 1 | 8.295*** | 8.311*** | 8.446*** | 8.259*** | 8.000*** | 7.800*** |
| 2 | 8.062*** | 8.139*** | 8.063*** | 8.057*** | 7.736*** | 7.589*** |
| 3 | 7.086*** | 7.098*** | 7.085*** | 7.055*** | 6.969*** | 6.820*** |
| 4 | 6.465*** | 6.686*** | 6.435*** | 6.477*** | 6.268*** | 6.376*** |
| 5 | 6.381*** | 6.515*** | 6.481*** | 6.360*** | 6.453*** | 6.454*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.599*** | 8.941*** | 8.833*** | 8.786*** | 8.562*** | 8.256*** |
| 1 | 7.551*** | 7.614*** | 7.567*** | 7.301*** | 7.130*** | 7.270*** |
| 2 | 6.684*** | 6.561*** | 6.561*** | 6.610*** | 6.662*** | 6.492*** |
| 3 | 5.855*** | 6.034*** | 5.885*** | 6.044*** | 5.886*** | 5.807*** |
| 4 | 5.358*** | 5.296*** | 5.384*** | 5.295*** | 5.389*** | 5.486*** |
| 5 | 5.150*** | 4.947*** | 4.934*** | 5.200*** | 5.388*** | 5.453*** |

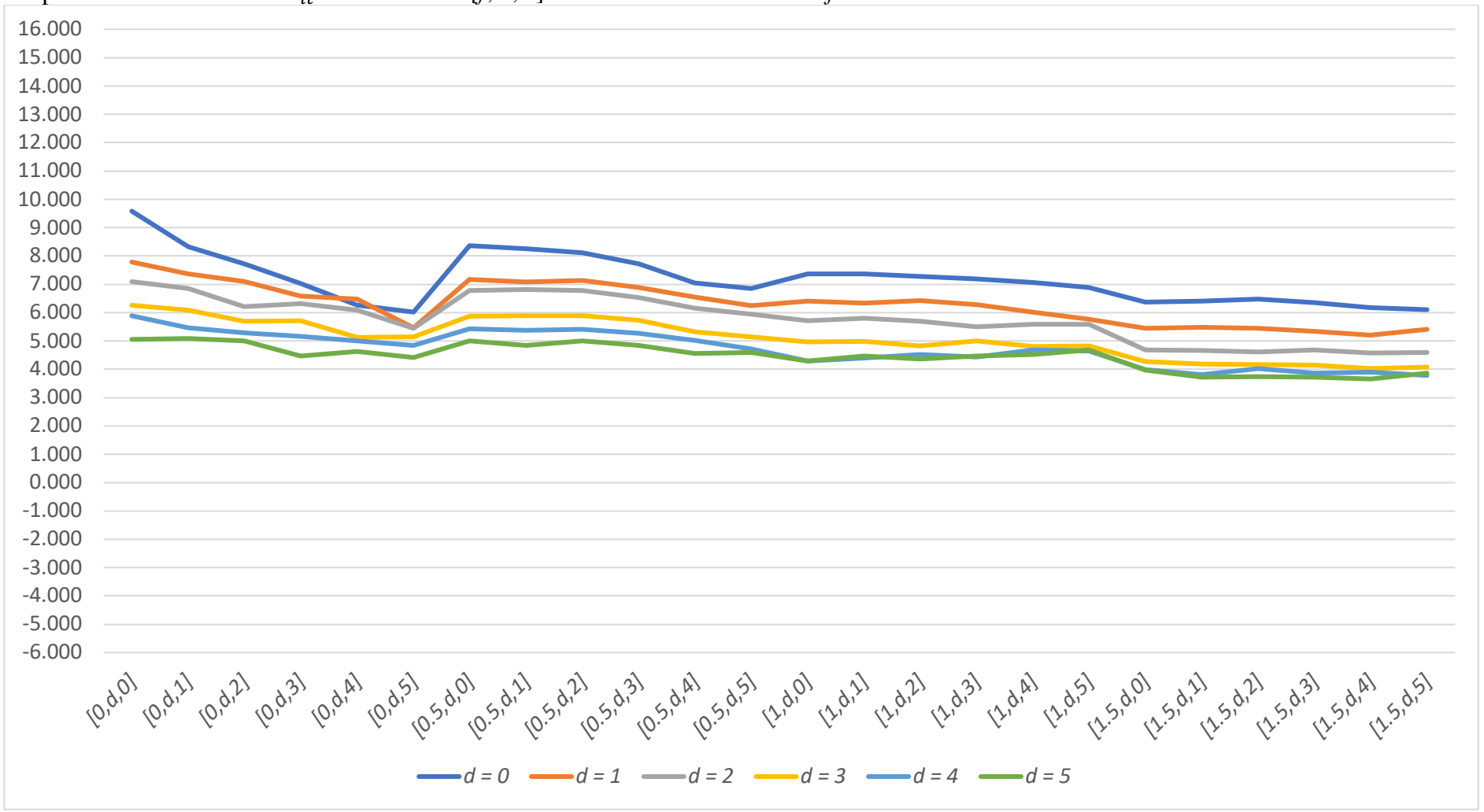
**Appendix 41: VW Developed excl. US S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



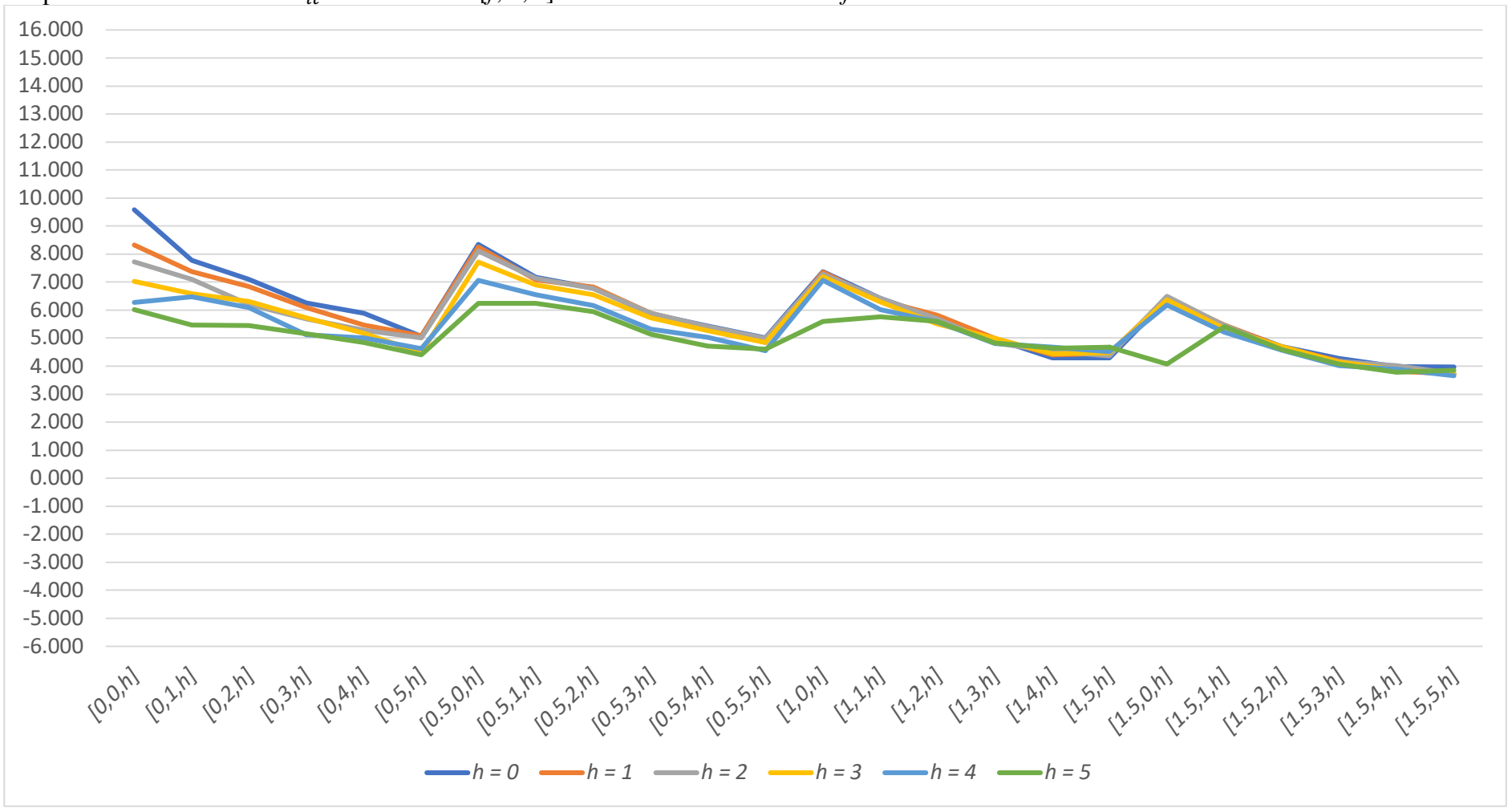
**Appendix 42: VW Developed excl. US S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 43: VW Developed excl. US S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 44: VW Developed excl. US S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.582*** | 8.323*** | 7.715*** | 7.022*** | 6.271*** | 6.019*** |
| 1 | 7.786*** | 7.366*** | 7.092*** | 6.591*** | 6.476*** | 5.459*** |
| 2 | 7.094*** | 6.846*** | 6.206*** | 6.318*** | 6.082*** | 5.440*** |
| 3 | 6.261*** | 6.087*** | 5.687*** | 5.715*** | 5.127*** | 5.147*** |
| 4 | 5.888*** | 5.473*** | 5.280*** | 5.169*** | 5.008*** | 4.839*** |
| 5 | 5.064*** | 5.087*** | 5.002*** | 4.474*** | 4.623*** | 4.407*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.354*** | 8.255*** | 8.108*** | 7.715*** | 7.054*** | 6.854*** |
| 1 | 7.178*** | 7.076*** | 7.142*** | 6.889*** | 6.545*** | 6.241*** |
| 2 | 6.785*** | 6.822*** | 6.775*** | 6.540*** | 6.160*** | 5.944*** |
| 3 | 5.876*** | 5.889*** | 5.889*** | 5.726*** | 5.317*** | 5.136*** |
| 4 | 5.435*** | 5.375*** | 5.415*** | 5.262*** | 5.020*** | 4.715*** |
| 5 | 5.005*** | 4.841*** | 4.994*** | 4.844*** | 4.550*** | 4.597*** |

***f = 1***

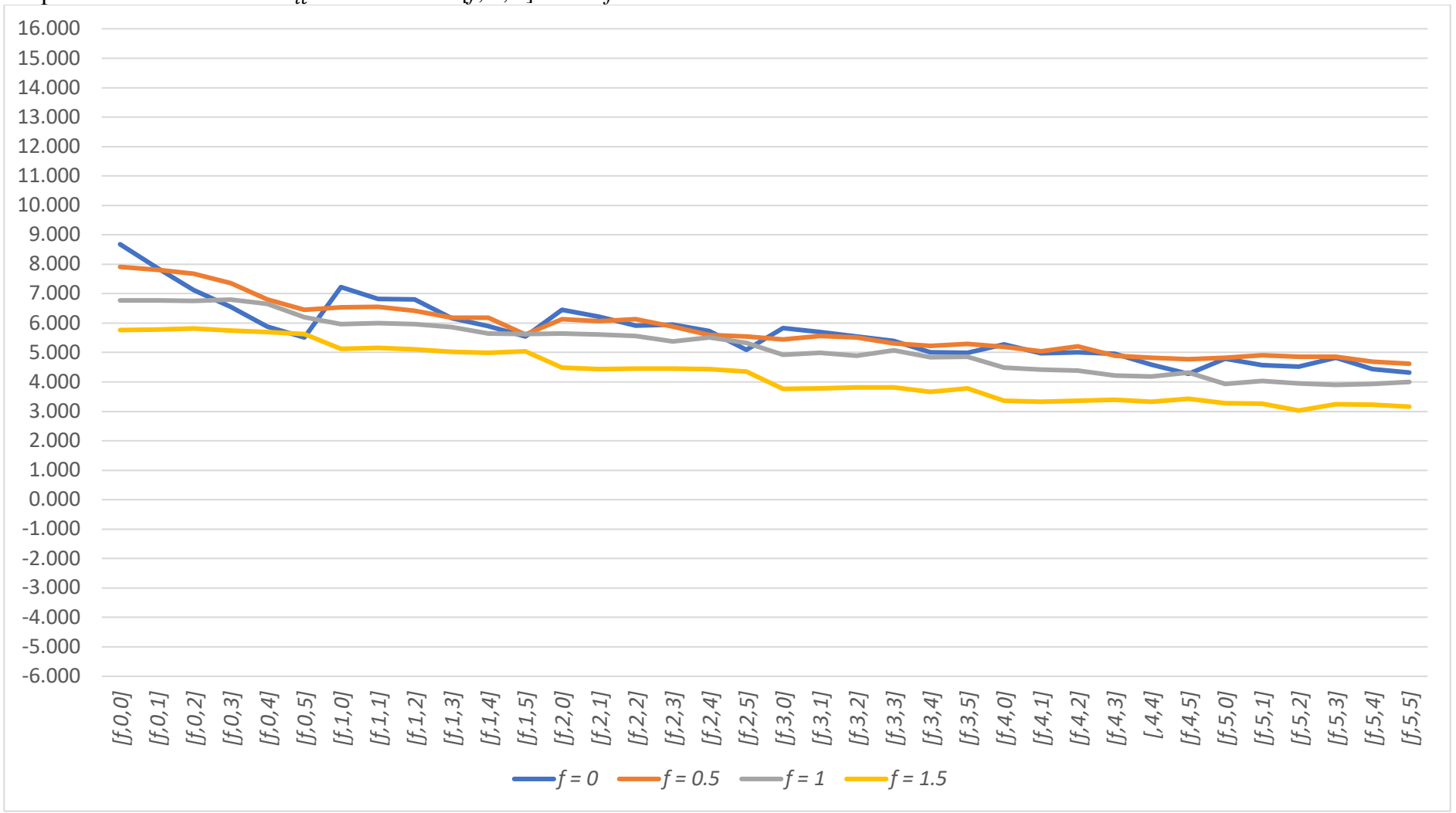
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.370*** | 7.786*** | 7.366*** | 7.092*** | 6.591*** | 6.476*** |
| 1 | 6.414*** | 6.338*** | 6.427*** | 6.290*** | 6.008*** | 5.760*** |
| 2 | 5.705*** | 5.809*** | 5.691*** | 5.505*** | 5.581*** | 5.590*** |
| 3 | 4.972*** | 4.982*** | 4.825*** | 4.997*** | 4.812*** | 4.832*** |
| 4 | 4.298*** | 4.404*** | 4.523*** | 4.440*** | 4.683*** | 4.638*** |
| 5 | 4.291*** | 4.467*** | 4.359*** | 4.470*** | 4.517*** | 4.677*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.379*** | 7.178*** | 7.076*** | 7.142*** | 6.889*** | 6.545*** |
| 1 | 5.444*** | 5.476*** | 5.440*** | 5.341*** | 5.205*** | 5.409*** |
| 2 | 4.689*** | 4.672*** | 4.619*** | 4.690*** | 4.575*** | 4.590*** |
| 3 | 4.273*** | 4.185*** | 4.158*** | 4.147*** | 4.027*** | 4.074*** |
| 4 | 3.984*** | 3.819*** | 4.027*** | 3.871*** | 3.897*** | 3.782*** |
| 5 | 3.971*** | 3.721*** | 3.734*** | 3.729*** | 3.657*** | 3.857*** |

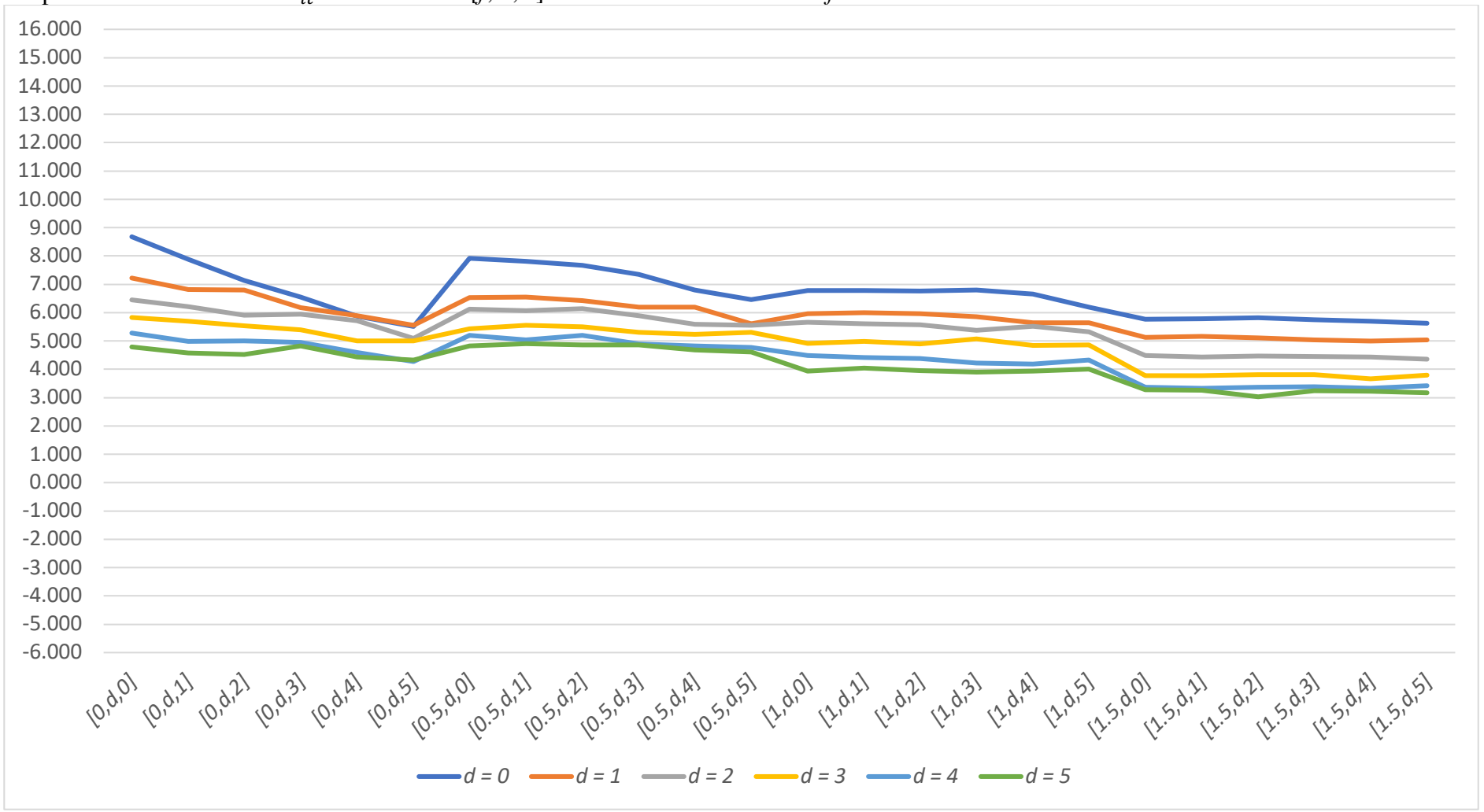
**Appendix 45: VW Developed excl. US S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



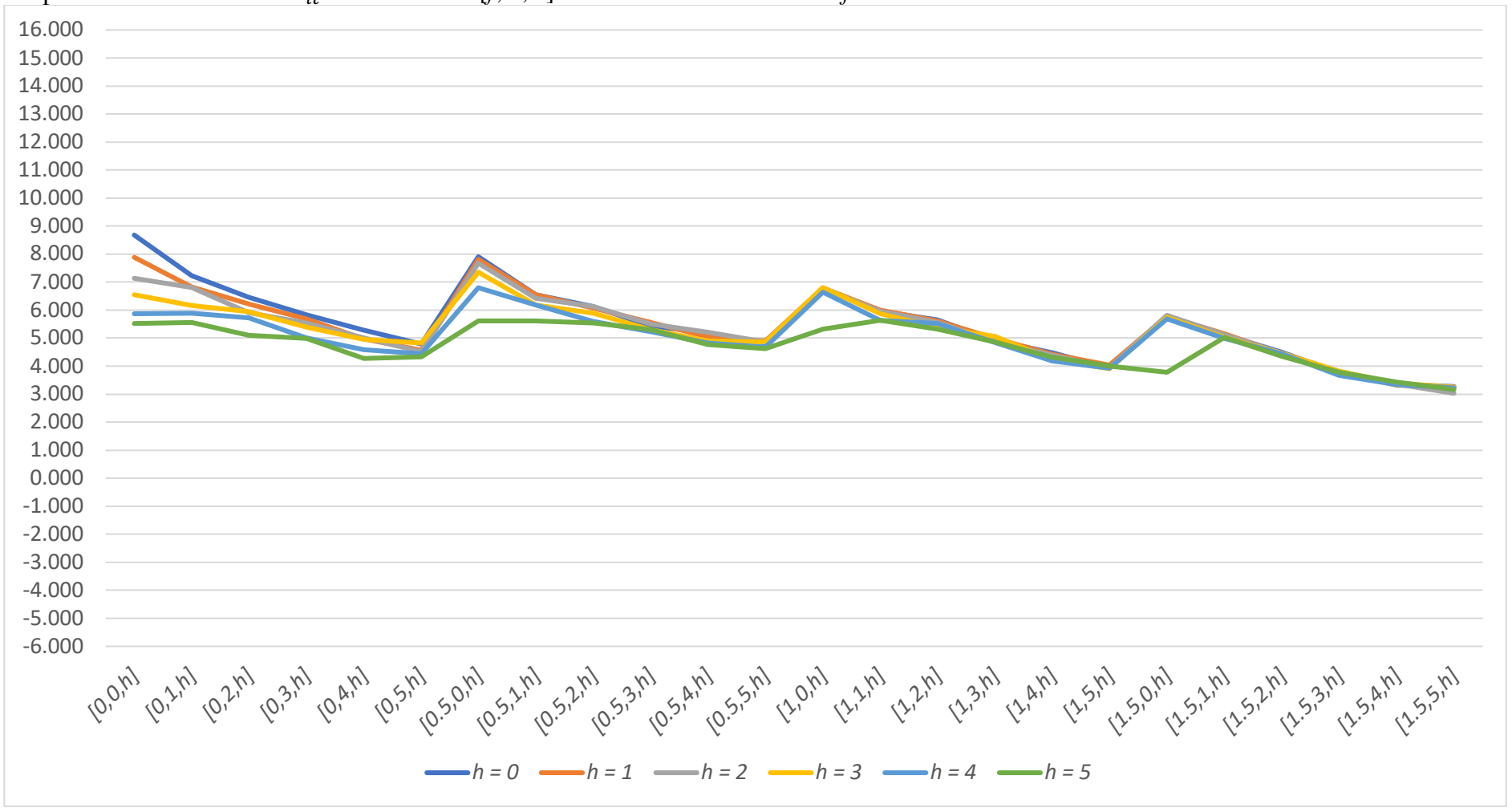
**Appendix 46: VW Developed excl. US S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 47: VW Developed excl. US S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 48: VW Developed excl. US S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.678*** | 7.885*** | 7.132*** | 6.556*** | 5.875*** | 5.513*** |
| 1 | 7.221*** | 6.815*** | 6.804*** | 6.170*** | 5.897*** | 5.552*** |
| 2 | 6.450*** | 6.214*** | 5.915*** | 5.944*** | 5.722*** | 5.099*** |
| 3 | 5.829*** | 5.688*** | 5.544*** | 5.399*** | 5.003*** | 4.998*** |
| 4 | 5.279*** | 4.977*** | 5.001*** | 4.954*** | 4.588*** | 4.276*** |
| 5 | 4.789*** | 4.576*** | 4.514*** | 4.817*** | 4.432*** | 4.323*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.910*** | 7.807*** | 7.676*** | 7.354*** | 6.799*** | 6.453*** |
| 1 | 6.540*** | 6.557*** | 6.426*** | 6.187*** | 6.188*** | 5.606*** |
| 2 | 6.127*** | 6.064*** | 6.136*** | 5.884*** | 5.594*** | 5.545*** |
| 3 | 5.437*** | 5.554*** | 5.508*** | 5.302*** | 5.225*** | 5.296*** |
| 4 | 5.190*** | 5.042*** | 5.205*** | 4.892*** | 4.823*** | 4.779*** |
| 5 | 4.827*** | 4.904*** | 4.863*** | 4.853*** | 4.685*** | 4.619*** |

***f = 1***

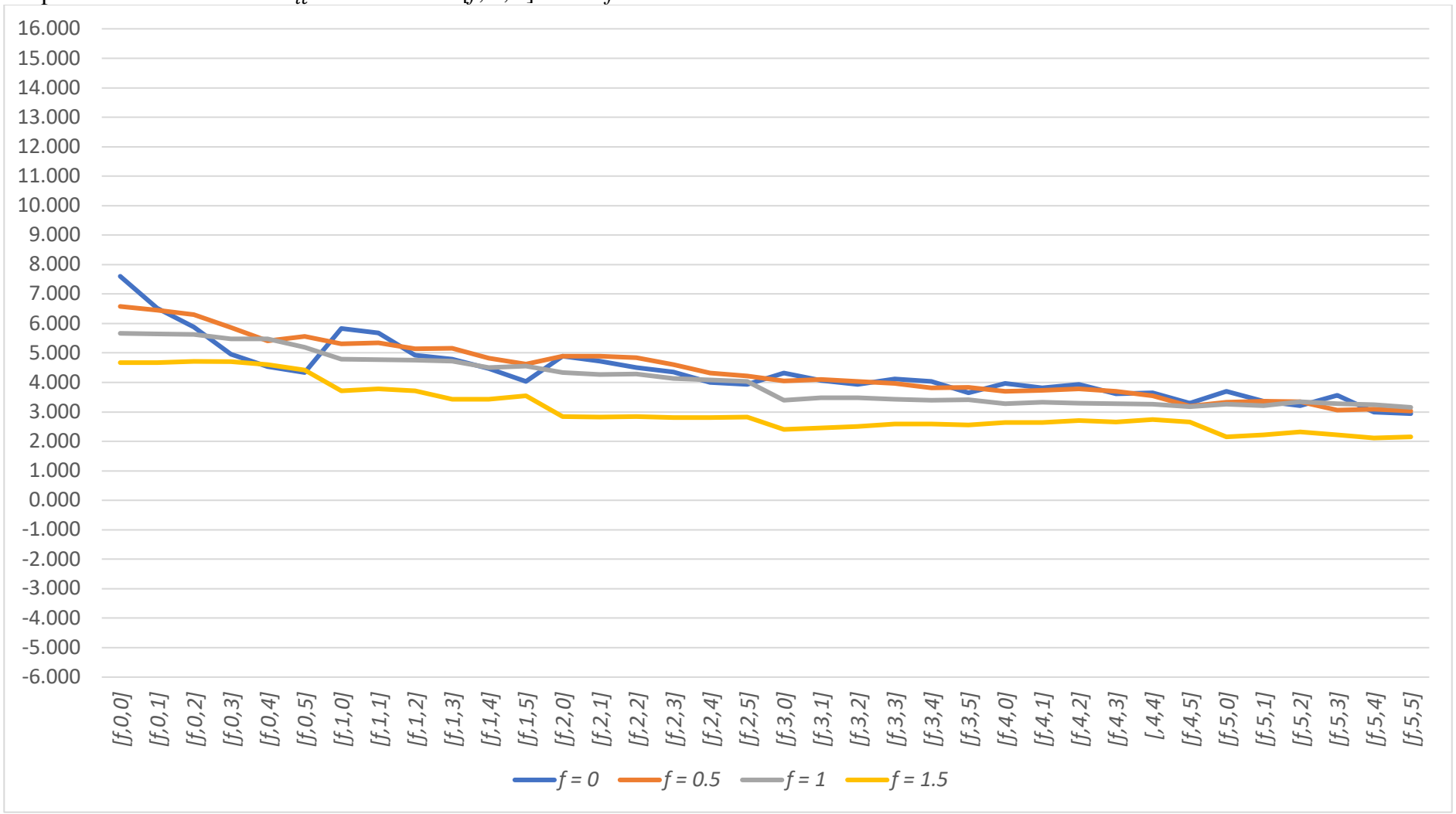
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.778*** | 7.221*** | 6.815*** | 6.804*** | 6.170*** | 5.897*** |
| 1 | 5.958*** | 5.997*** | 5.965*** | 5.862*** | 5.640*** | 5.637*** |
| 2 | 5.652*** | 5.608*** | 5.563*** | 5.378*** | 5.518*** | 5.319*** |
| 3 | 4.919*** | 4.988*** | 4.888*** | 5.071*** | 4.841*** | 4.853*** |
| 4 | 4.485*** | 4.418*** | 4.388*** | 4.221*** | 4.192*** | 4.319*** |
| 5 | 3.930*** | 4.039*** | 3.949*** | 3.901*** | 3.936*** | 4.005*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.771*** | 6.540*** | 6.557*** | 6.426*** | 6.187*** | 6.188*** |
| 1 | 5.125*** | 5.158*** | 5.111*** | 5.033*** | 4.997*** | 5.035*** |
| 2 | 4.494*** | 4.435*** | 4.460*** | 4.451*** | 4.437*** | 4.357*** |
| 3 | 3.768*** | 3.778*** | 3.811*** | 3.813*** | 3.664*** | 3.788*** |
| 4 | 3.360*** | 3.329*** | 3.359*** | 3.390*** | 3.334*** | 3.425*** |
| 5 | 3.273*** | 3.253*** | 3.030*** | 3.247*** | 3.222*** | 3.164*** |

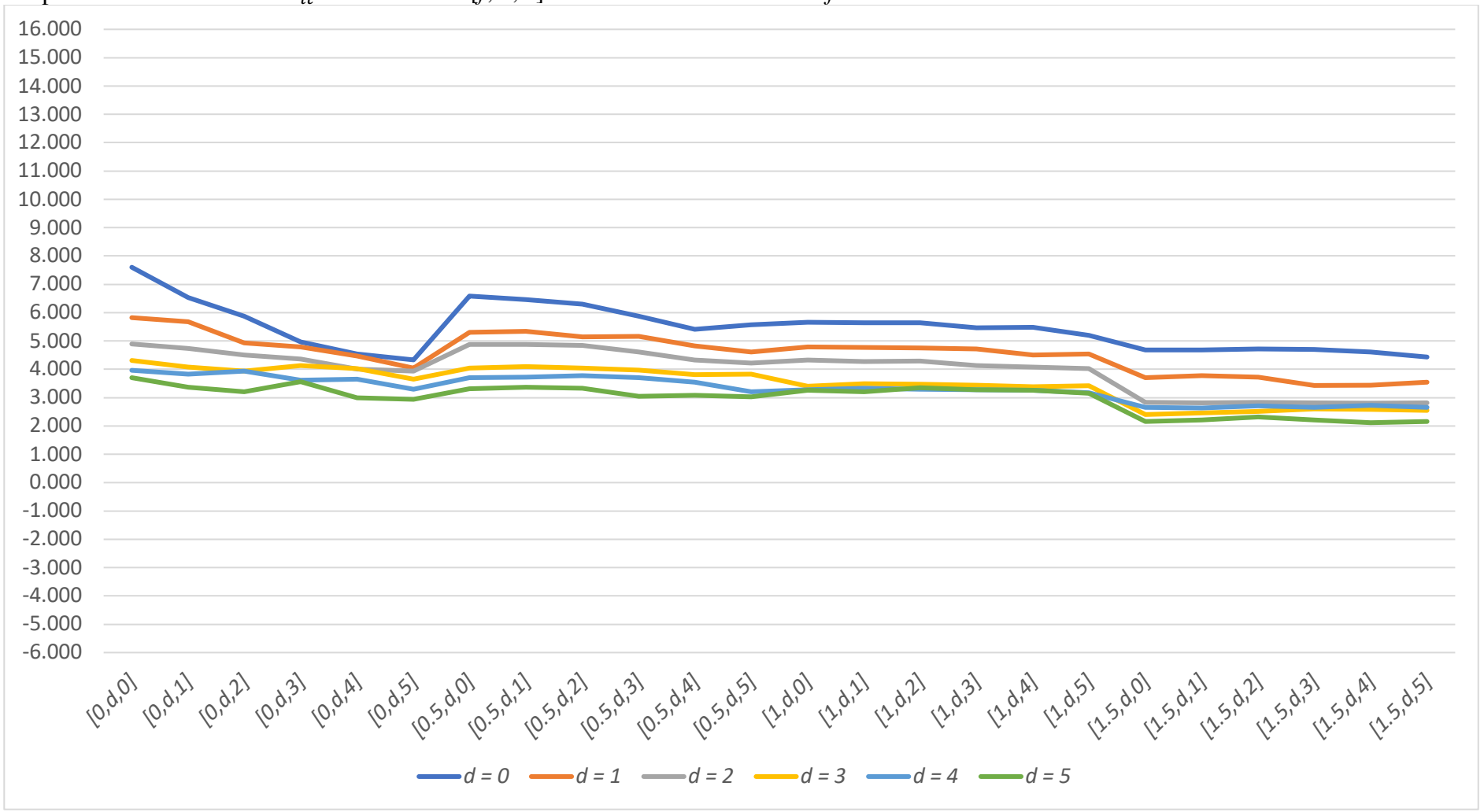
**Appendix 49: VW Developed excl. US S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



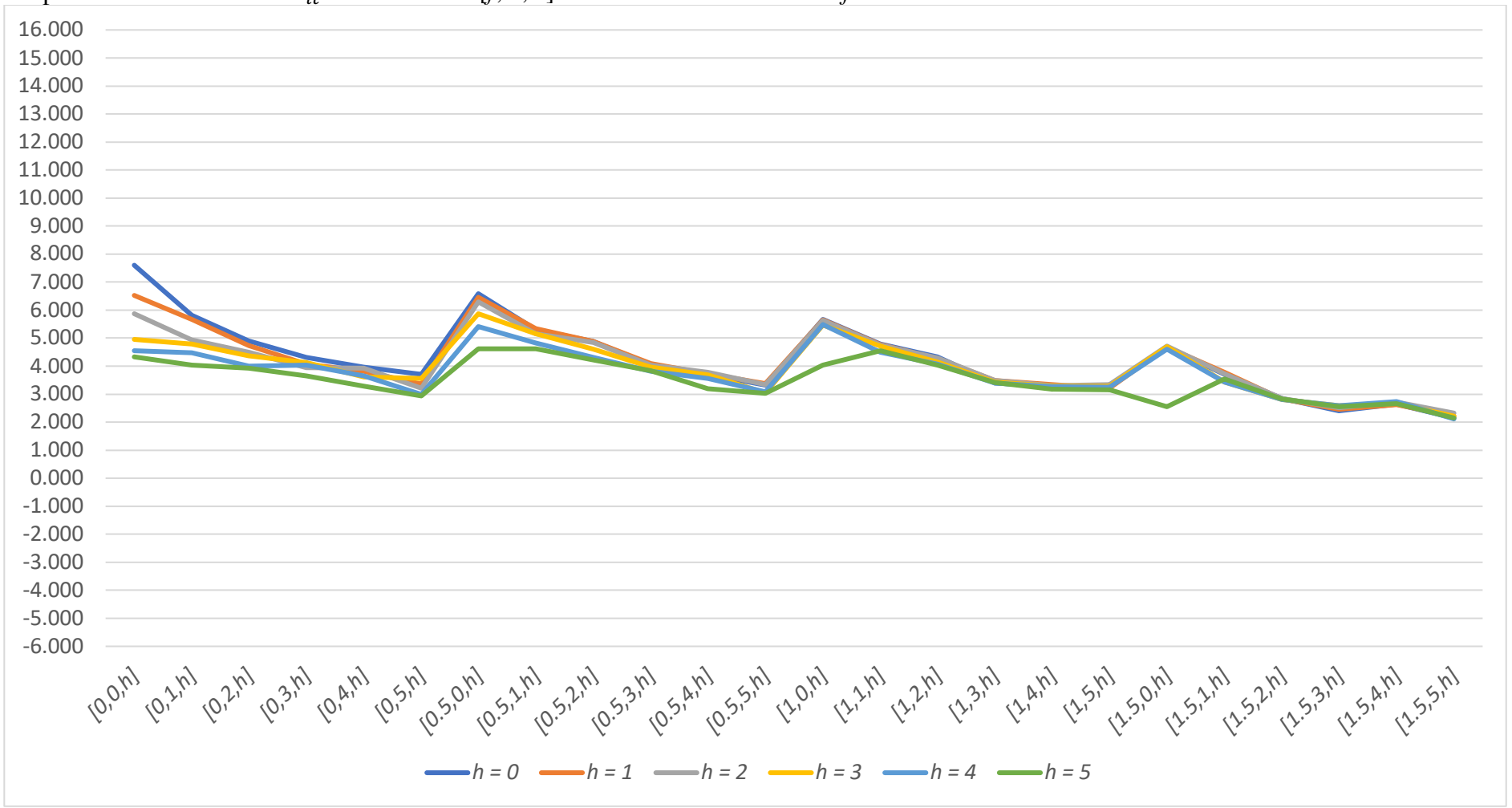
**Appendix 50: VW Developed excl. US S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 51: VW Developed excl. US S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 52: VW Developed excl. US S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.602*** | 6.524*** | 5.877*** | 4.959*** | 4.542*** | 4.332*** |
| 1 | 5.823*** | 5.676*** | 4.927*** | 4.791*** | 4.475*** | 4.041*** |
| 2 | 4.894*** | 4.729*** | 4.496*** | 4.360*** | 4.002*** | 3.928*** |
| 3 | 4.311*** | 4.073*** | 3.939*** | 4.126*** | 4.029*** | 3.645*** |
| 4 | 3.964*** | 3.820*** | 3.930*** | 3.608*** | 3.654*** | 3.293*** |
| 5 | 3.703*** | 3.360*** | 3.213*** | 3.565*** | 2.998*** | 2.941*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.579*** | 6.460*** | 6.294*** | 5.870*** | 5.419*** | 5.563*** |
| 1 | 5.305*** | 5.341*** | 5.149*** | 5.161*** | 4.818*** | 4.619*** |
| 2 | 4.886*** | 4.883*** | 4.839*** | 4.609*** | 4.318*** | 4.226*** |
| 3 | 4.049*** | 4.101*** | 4.042*** | 3.970*** | 3.811*** | 3.827*** |
| 4 | 3.699*** | 3.724*** | 3.777*** | 3.696*** | 3.552*** | 3.200*** |
| 5 | 3.322*** | 3.370*** | 3.339*** | 3.053*** | 3.086*** | 3.031*** |

***f = 1***

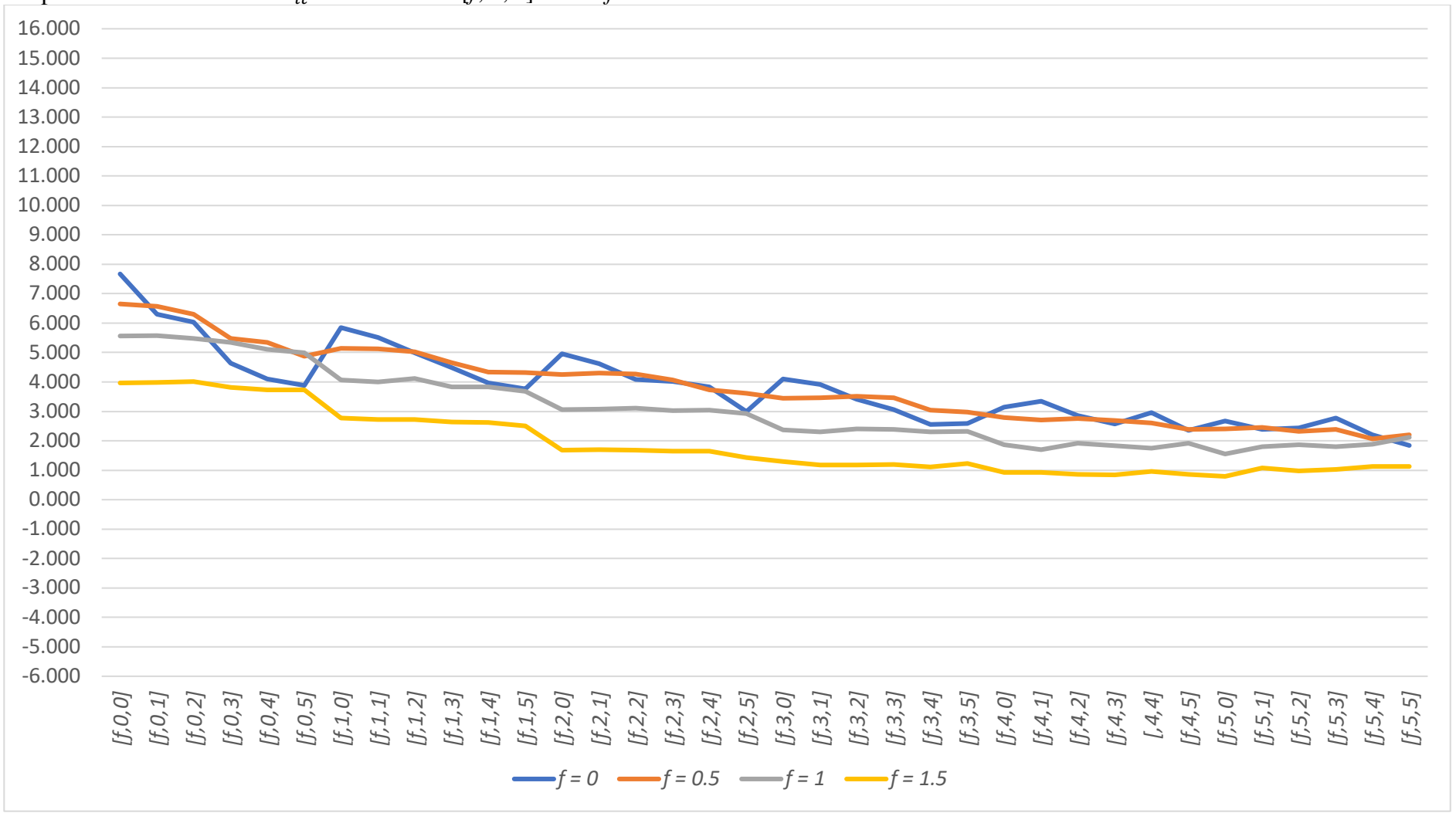
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.666*** | 5.823*** | 5.676*** | 4.927*** | 4.791*** | 4.475*** |
| 1 | 4.789*** | 4.765*** | 4.754*** | 4.714*** | 4.498*** | 4.547*** |
| 2 | 4.333*** | 4.277*** | 4.285*** | 4.139*** | 4.081*** | 4.031*** |
| 3 | 3.403*** | 3.483*** | 3.481*** | 3.436*** | 3.392*** | 3.416*** |
| 4 | 3.281*** | 3.336*** | 3.298*** | 3.282*** | 3.265*** | 3.179*** |
| 5 | 3.259*** | 3.204*** | 3.345*** | 3.284*** | 3.251*** | 3.154*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.675*** | 5.305*** | 5.341*** | 5.149*** | 5.161*** | 4.818*** |
| 1 | 3.708*** | 3.775*** | 3.718*** | 3.429*** | 3.435*** | 3.539*** |
| 2 | 2.837*** | 2.823*** | 2.837*** | 2.816*** | 2.804*** | 2.822*** |
| 3 | 2.403*** | 2.463*** | 2.509*** | 2.595*** | 2.592*** | 2.549*** |
| 4 | 2.648*** | 2.634*** | 2.712*** | 2.659*** | 2.735*** | 2.659*** |
| 5 | 2.150** | 2.218** | 2.325*** | 2.216** | 2.115** | 2.151** |

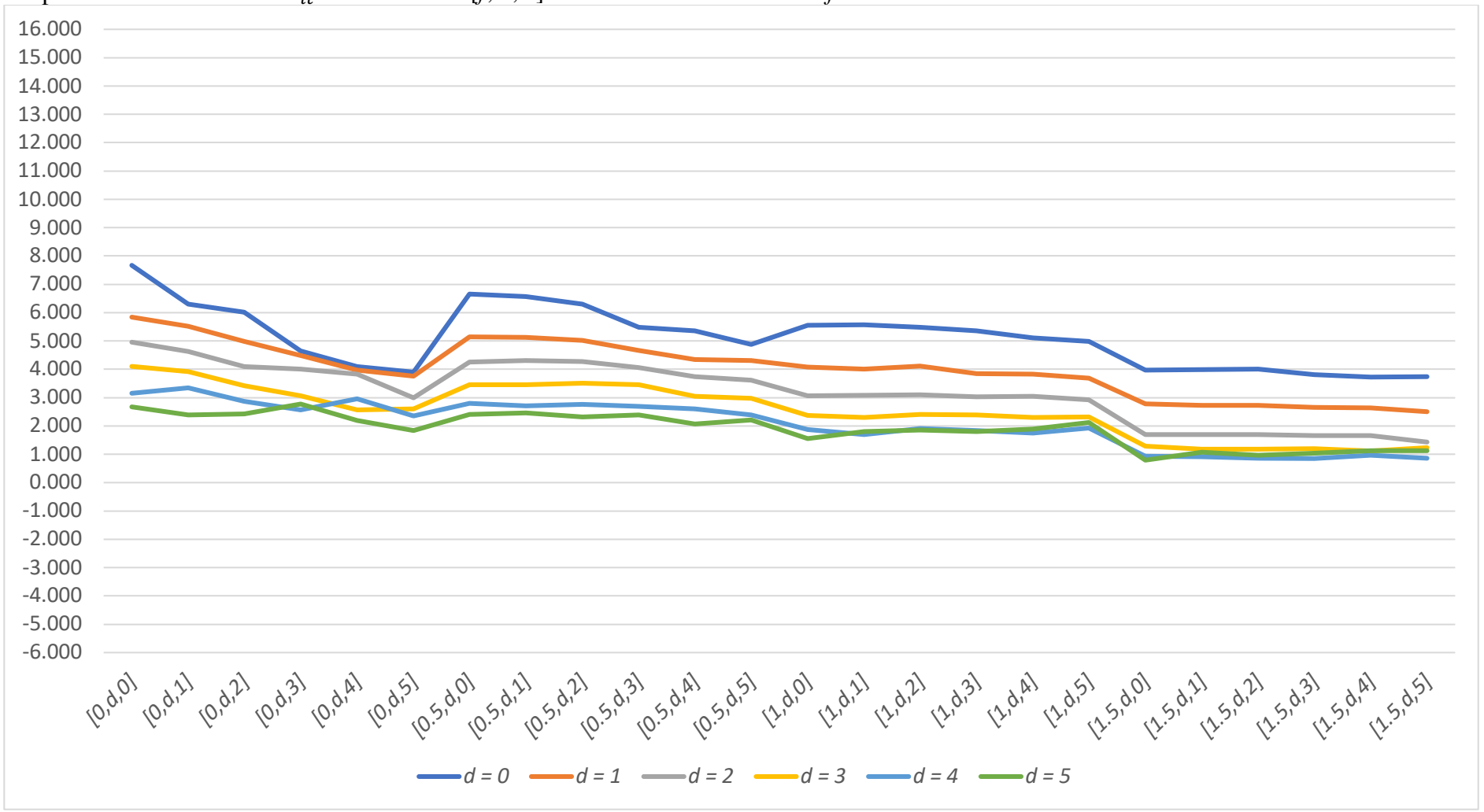
**Appendix 53: EW Developed excl. US S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



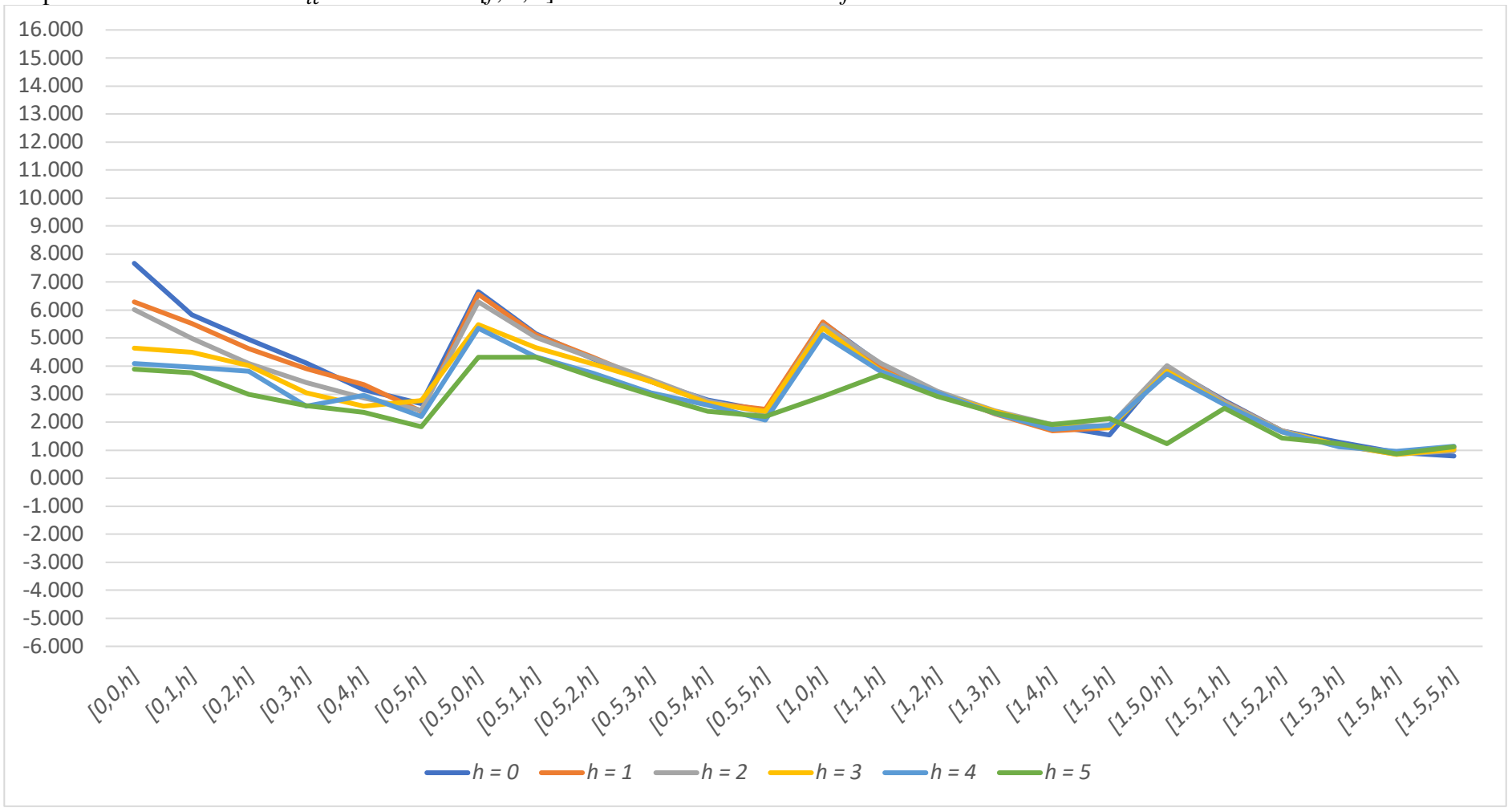
**Appendix 54: EW Developed excl. US S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 55: EW Developed excl. US S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 56: EW Developed excl. US S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.670*** | 6.301*** | 6.024*** | 4.641*** | 4.101*** | 3.891*** |
| 1 | 5.841*** | 5.516*** | 4.991*** | 4.492*** | 3.973*** | 3.757*** |
| 2 | 4.957*** | 4.626*** | 4.091*** | 4.012*** | 3.826*** | 2.996*** |
| 3 | 4.102*** | 3.913*** | 3.412*** | 3.056*** | 2.562** | 2.596** |
| 4 | 3.149*** | 3.345*** | 2.860*** | 2.575** | 2.960*** | 2.356** |
| 5 | 2.666** | 2.392** | 2.431** | 2.774** | 2.201** | 1.843* |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.651*** | 6.566*** | 6.295*** | 5.482*** | 5.352*** | 4.872*** |
| 1 | 5.148*** | 5.121*** | 5.023*** | 4.662*** | 4.337*** | 4.316*** |
| 2 | 4.260*** | 4.309*** | 4.273*** | 4.065*** | 3.737*** | 3.619*** |
| 3 | 3.451*** | 3.459*** | 3.517*** | 3.456*** | 3.039*** | 2.976*** |
| 4 | 2.790** | 2.708** | 2.760** | 2.685** | 2.610** | 2.380** |
| 5 | 2.409** | 2.459** | 2.325** | 2.386** | 2.067* | 2.202* |

***f = 1***

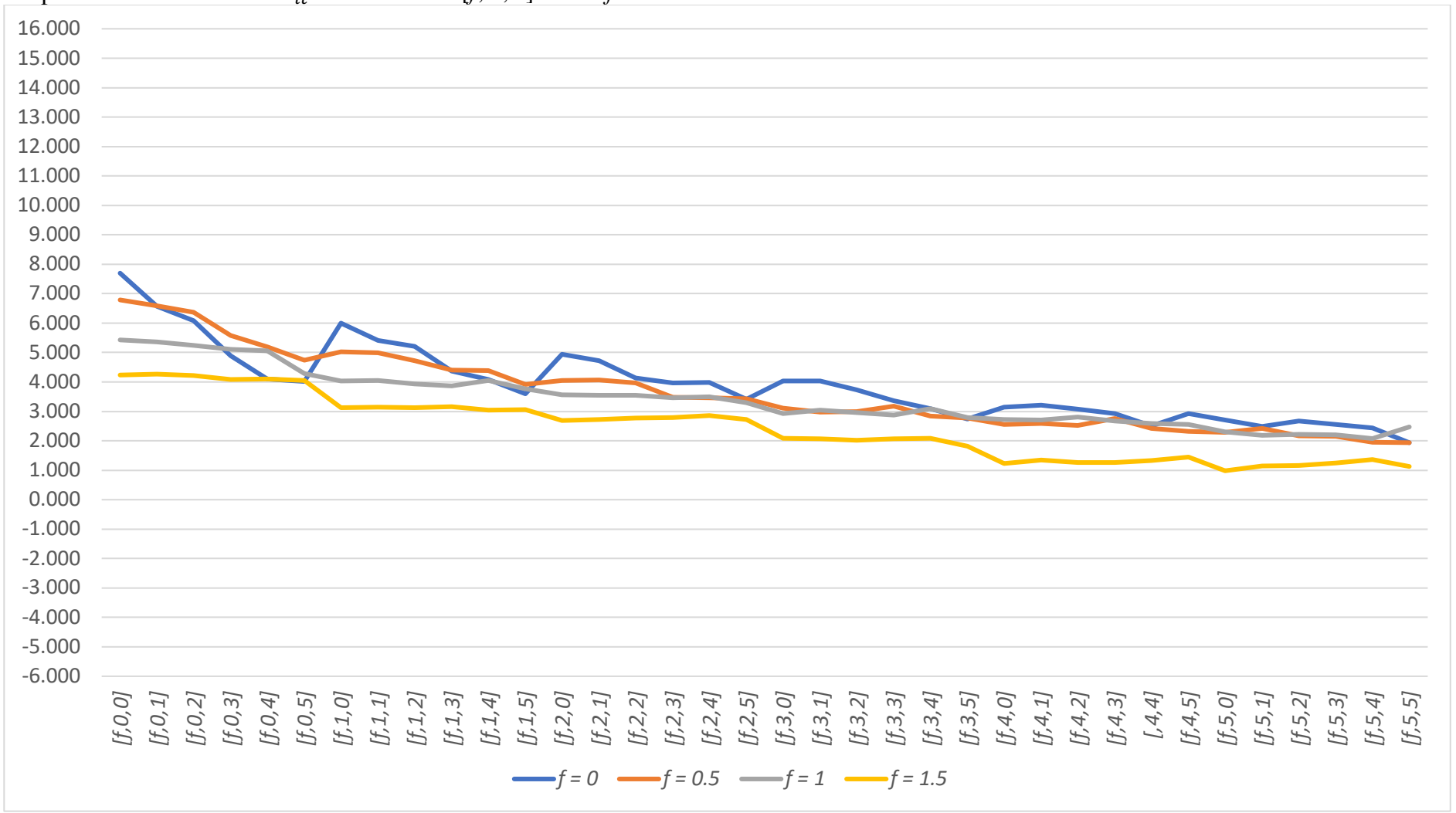
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.554*** | 5.841*** | 5.516*** | 4.991*** | 4.492*** | 3.973*** |
| 1 | 4.075*** | 3.998*** | 4.116*** | 3.840*** | 3.826*** | 3.686*** |
| 2 | 3.066*** | 3.076*** | 3.102*** | 3.024*** | 3.044*** | 2.922*** |
| 3 | 2.378** | 2.302** | 2.407** | 2.385** | 2.307** | 2.326** |
| 4 | 1.867 | 1.694 | 1.912* | 1.842 | 1.746 | 1.918* |
| 5 | 1.553 | 1.808 | 1.864* | 1.797 | 1.891* | 2.126* |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.963*** | 5.148*** | 5.121*** | 5.023*** | 4.662*** | 4.337*** |
| 1 | 2.775** | 2.731** | 2.726** | 2.648** | 2.630** | 2.503** |
| 2 | 1.688 | 1.697 | 1.690 | 1.652 | 1.657 | 1.431 |
| 3 | 1.292 | 1.176 | 1.178 | 1.194 | 1.116 | 1.230 |
| 4 | 0.922 | 0.920 | 0.857 | 0.850 | 0.960 | 0.868 |
| 5 | 0.792 | 1.079 | 0.972 | 1.029 | 1.135 | 1.131 |

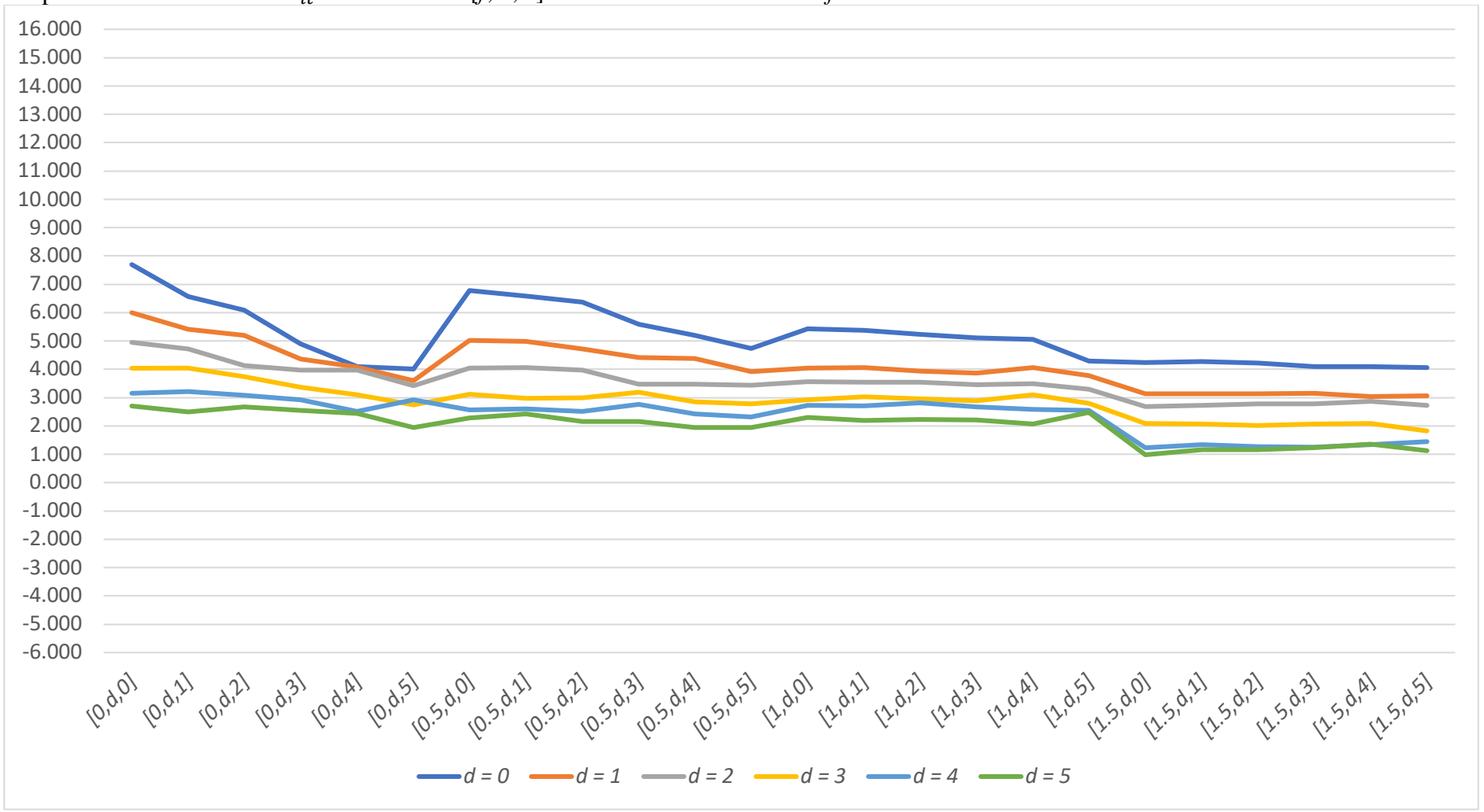
**Appendix 57: EW Developed excl. US S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



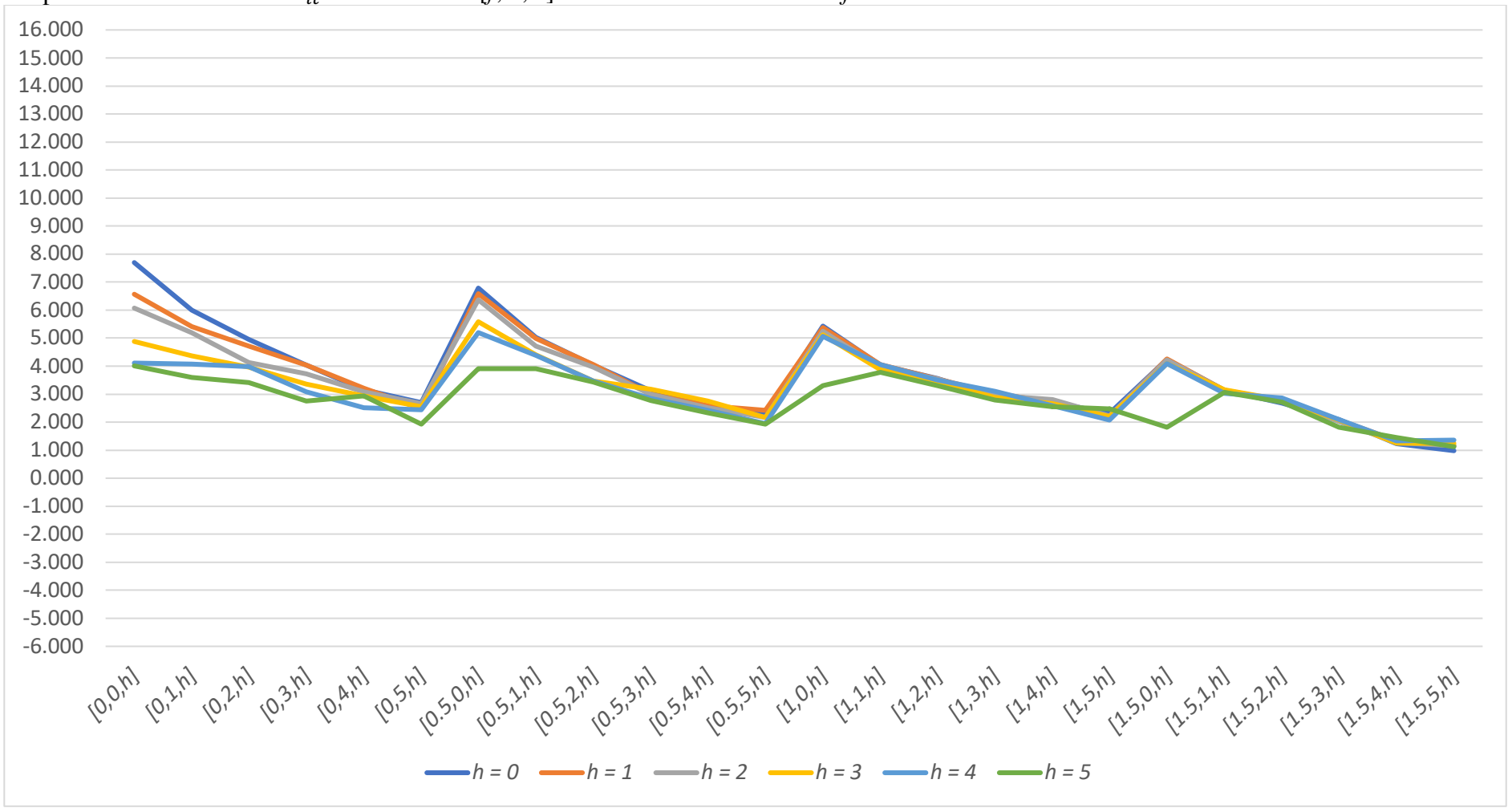
**Appendix 58: EW Developed excl. US S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 59: EW Developed excl. US S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 60: EW Developed excl. US S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.697*** | 6.572*** | 6.078*** | 4.888*** | 4.103*** | 4.009*** |
| 1 | 5.998*** | 5.411*** | 5.201*** | 4.370*** | 4.080*** | 3.604*** |
| 2 | 4.949*** | 4.717*** | 4.137*** | 3.970*** | 3.979*** | 3.420*** |
| 3 | 4.038*** | 4.037*** | 3.734*** | 3.360*** | 3.091*** | 2.747** |
| 4 | 3.151*** | 3.214*** | 3.078*** | 2.930*** | 2.513** | 2.930*** |
| 5 | 2.703** | 2.488** | 2.666** | 2.555** | 2.436** | 1.936* |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.787*** | 6.588*** | 6.369*** | 5.585*** | 5.198*** | 4.739*** |
| 1 | 5.028*** | 4.988*** | 4.720*** | 4.410*** | 4.380*** | 3.915*** |
| 2 | 4.045*** | 4.062*** | 3.972*** | 3.478*** | 3.470*** | 3.432*** |
| 3 | 3.116*** | 2.984*** | 2.996*** | 3.182*** | 2.849** | 2.774** |
| 4 | 2.563** | 2.597** | 2.518** | 2.759** | 2.419** | 2.325** |
| 5 | 2.279** | 2.425** | 2.164* | 2.161* | 1.948* | 1.937* |

***f = 1***

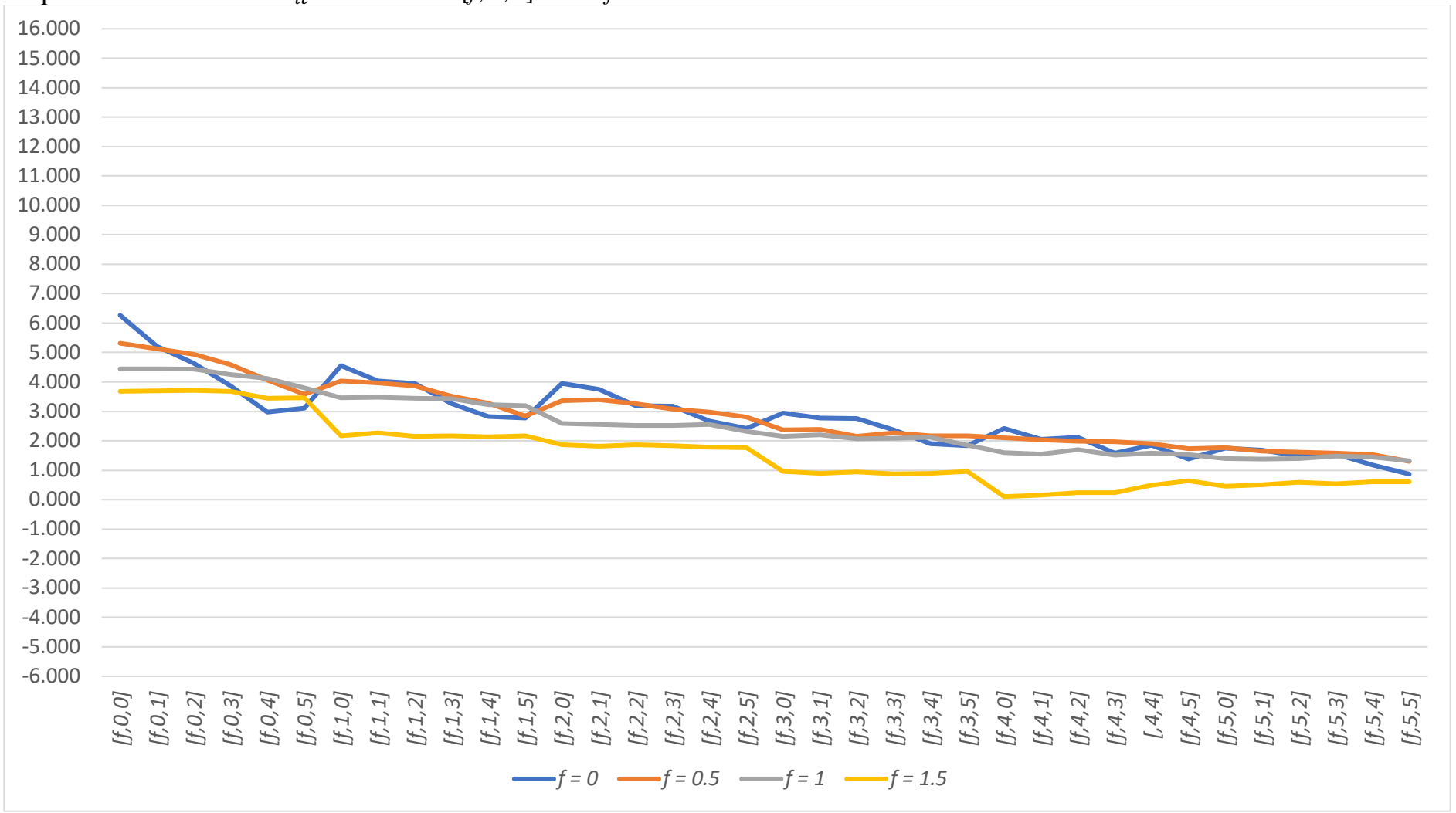
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.428*** | 5.998*** | 5.411*** | 5.201*** | 4.370*** | 4.080*** |
| 1 | 4.041*** | 4.054*** | 3.941*** | 3.872*** | 4.058*** | 3.773*** |
| 2 | 3.557*** | 3.546*** | 3.550*** | 3.457*** | 3.498*** | 3.301*** |
| 3 | 2.922** | 3.035*** | 2.959*** | 2.878** | 3.095*** | 2.790** |
| 4 | 2.721** | 2.715** | 2.807** | 2.669** | 2.587** | 2.553** |
| 5 | 2.307** | 2.193* | 2.228* | 2.206* | 2.077* | 2.475** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.239*** | 5.028*** | 4.988*** | 4.720*** | 4.410*** | 4.380*** |
| 1 | 3.133*** | 3.142*** | 3.132*** | 3.160*** | 3.038*** | 3.068*** |
| 2 | 2.684** | 2.729** | 2.779** | 2.786** | 2.866** | 2.720** |
| 3 | 2.085* | 2.068* | 2.024* | 2.073* | 2.085* | 1.824 |
| 4 | 1.230 | 1.348 | 1.265 | 1.259 | 1.333 | 1.448 |
| 5 | 0.982 | 1.153 | 1.158 | 1.241 | 1.365 | 1.125 |

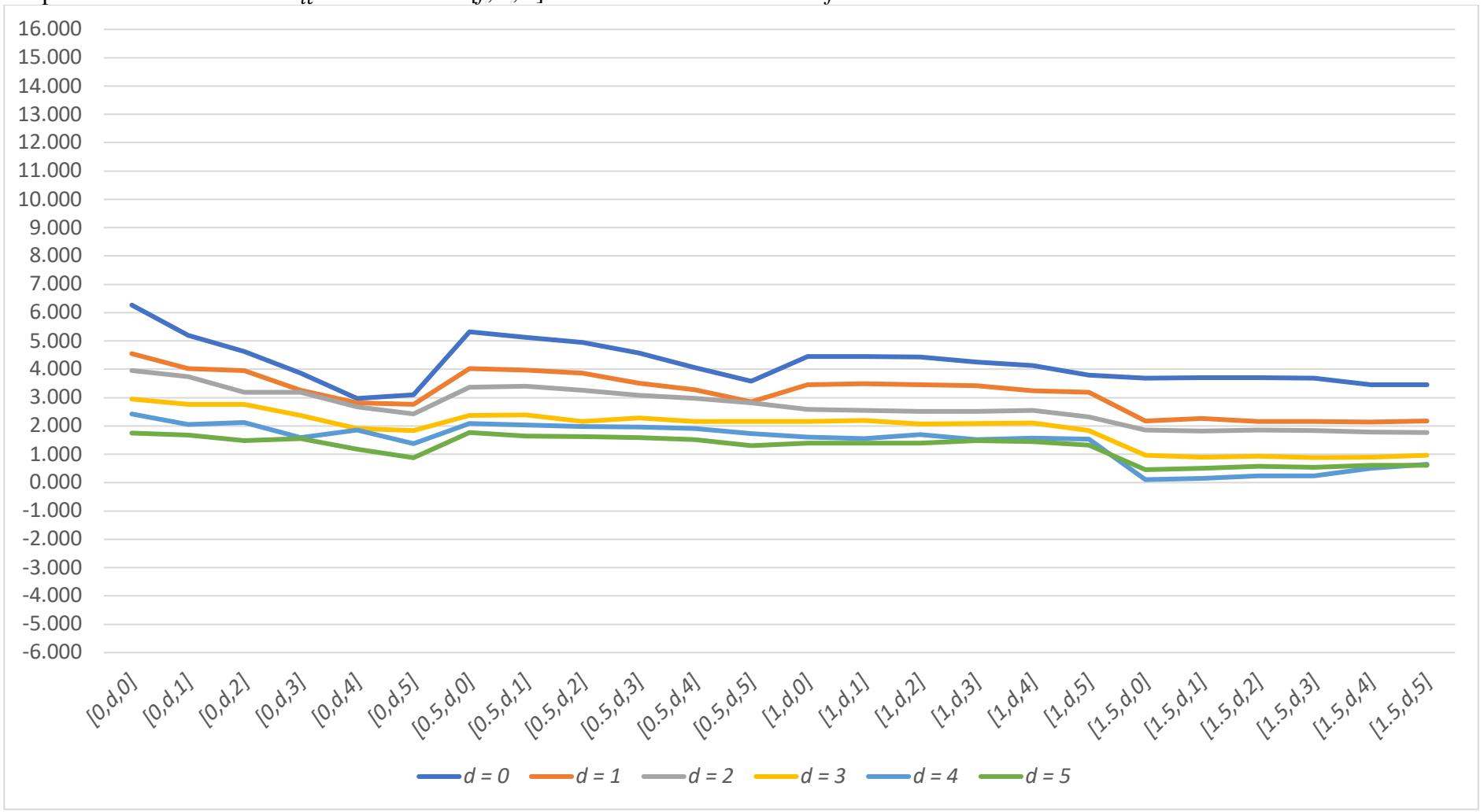
**Appendix 61: EW Developed excl. US S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



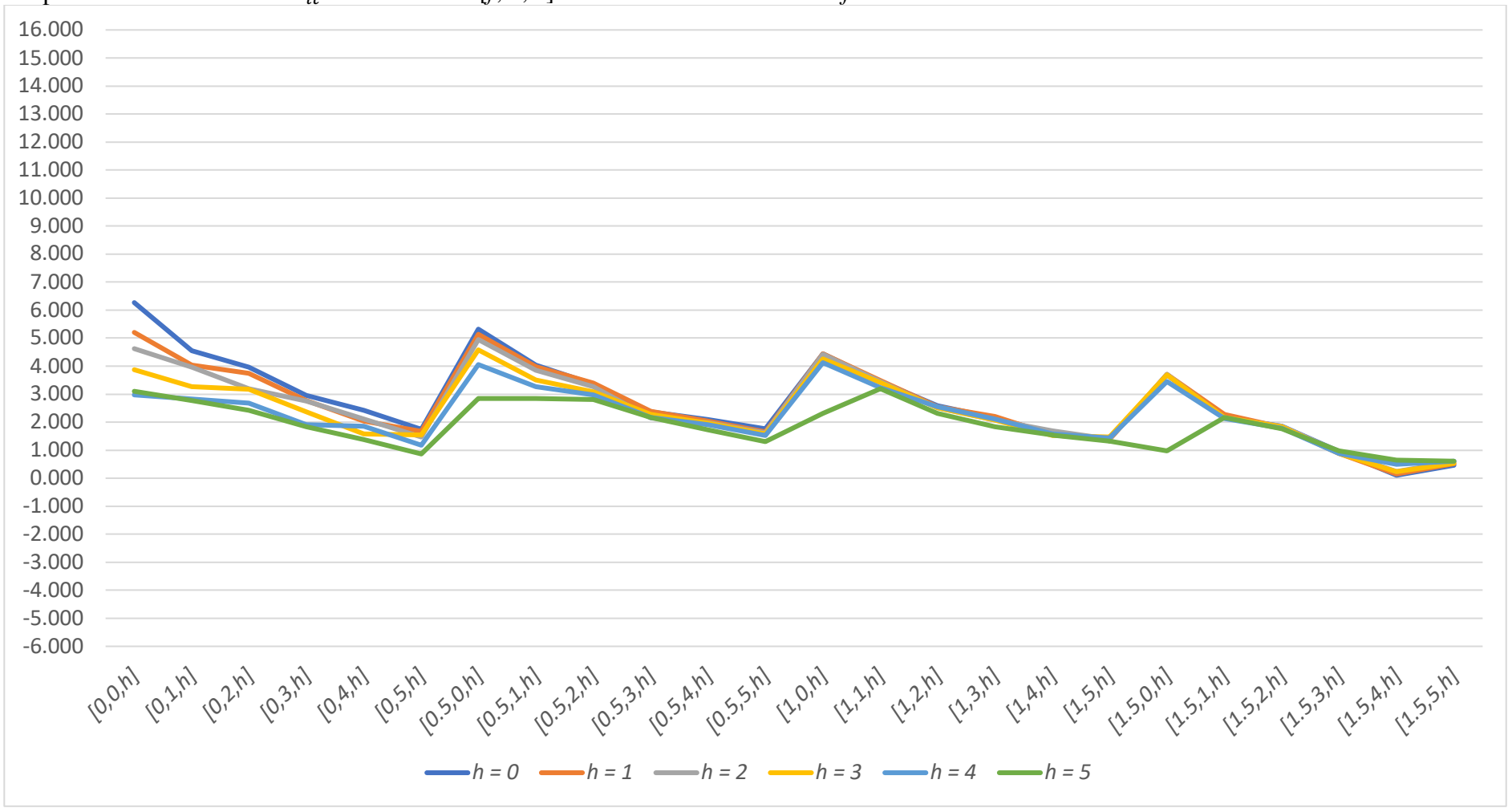
**Appendix 62: EW Developed excl. US S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 63: EW Developed excl. US S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 64: EW Developed excl. US S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.268*** | 5.204*** | 4.632*** | 3.873*** | 2.971*** | 3.102*** |
| 1 | 4.552*** | 4.030*** | 3.957*** | 3.260*** | 2.823*** | 2.770*** |
| 2 | 3.956*** | 3.747*** | 3.196*** | 3.184*** | 2.676*** | 2.429** |
| 3 | 2.949*** | 2.768*** | 2.757*** | 2.366** | 1.905* | 1.834* |
| 4 | 2.422** | 2.047** | 2.114** | 1.580 | 1.849* | 1.382 |
| 5 | 1.746* | 1.678 | 1.475 | 1.548 | 1.177 | 0.869 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.315*** | 5.133*** | 4.949*** | 4.581*** | 4.061*** | 3.585*** |
| 1 | 4.033*** | 3.974*** | 3.862*** | 3.507*** | 3.272*** | 2.842*** |
| 2 | 3.368*** | 3.402*** | 3.261*** | 3.080*** | 2.981*** | 2.809*** |
| 3 | 2.371** | 2.389** | 2.152** | 2.276** | 2.166** | 2.163** |
| 4 | 2.095** | 2.034* | 1.977* | 1.965* | 1.907* | 1.735* |
| 5 | 1.768* | 1.650 | 1.622 | 1.589 | 1.524 | 1.302 |

***f = 1***

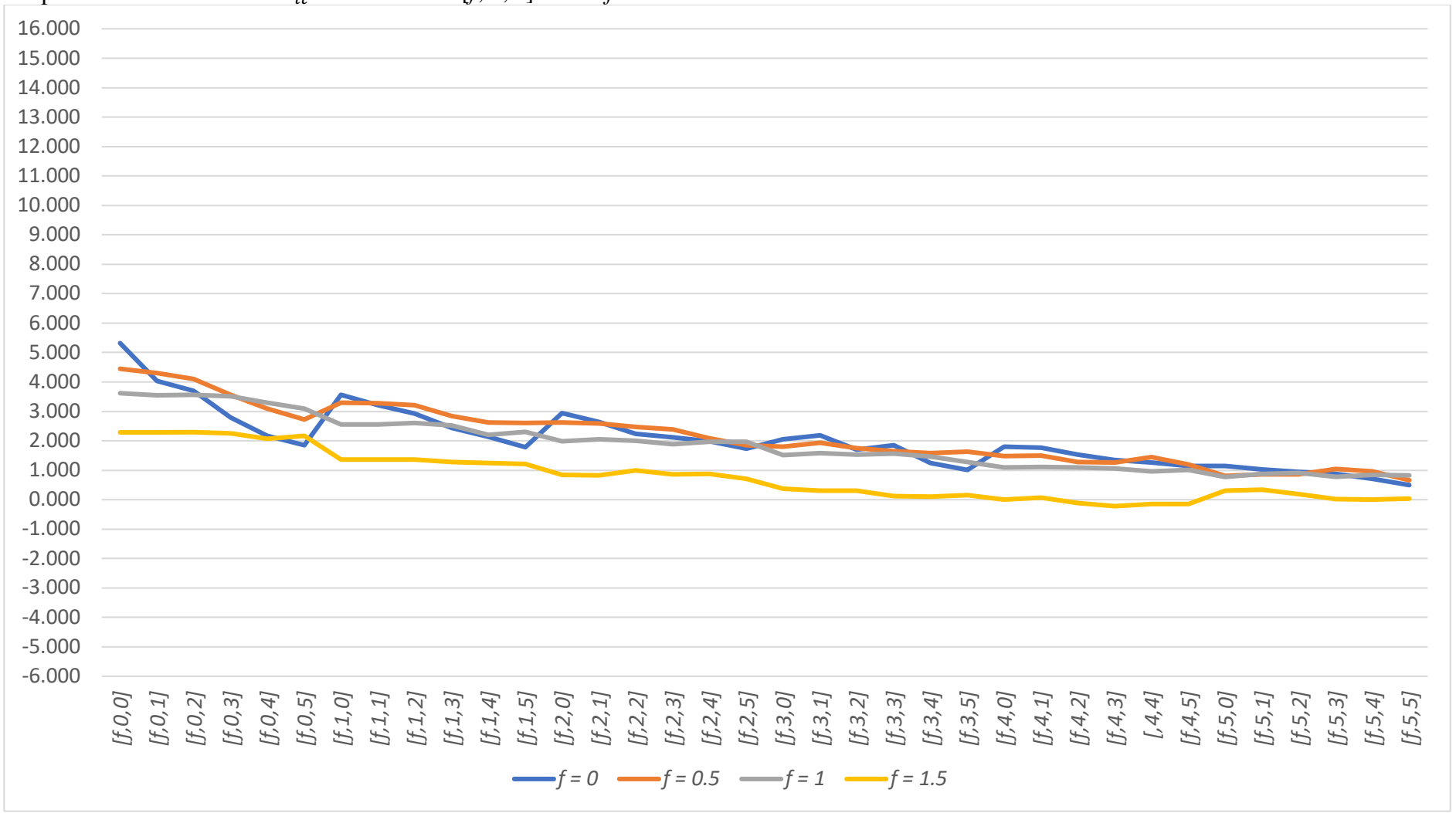
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.444*** | 4.552*** | 4.030*** | 3.957*** | 3.260*** | 2.823*** |
| 1 | 3.458*** | 3.485*** | 3.454*** | 3.421*** | 3.236*** | 3.195*** |
| 2 | 2.587** | 2.548** | 2.519** | 2.521** | 2.557** | 2.316** |
| 3 | 2.153** | 2.200** | 2.075* | 2.082** | 2.113** | 1.845* |
| 4 | 1.602 | 1.549 | 1.696 | 1.520 | 1.576 | 1.537 |
| 5 | 1.394 | 1.386 | 1.399 | 1.474 | 1.443 | 1.322 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.687*** | 4.033*** | 3.974*** | 3.862*** | 3.507*** | 3.272*** |
| 1 | 2.172** | 2.269** | 2.154** | 2.162** | 2.137** | 2.168** |
| 2 | 1.864* | 1.818* | 1.861* | 1.841* | 1.778* | 1.767* |
| 3 | 0.960 | 0.892 | 0.939 | 0.883 | 0.892 | 0.968 |
| 4 | 0.105 | 0.148 | 0.239 | 0.232 | 0.496 | 0.638 |
| 5 | 0.456 | 0.509 | 0.583 | 0.544 | 0.613 | 0.608 |

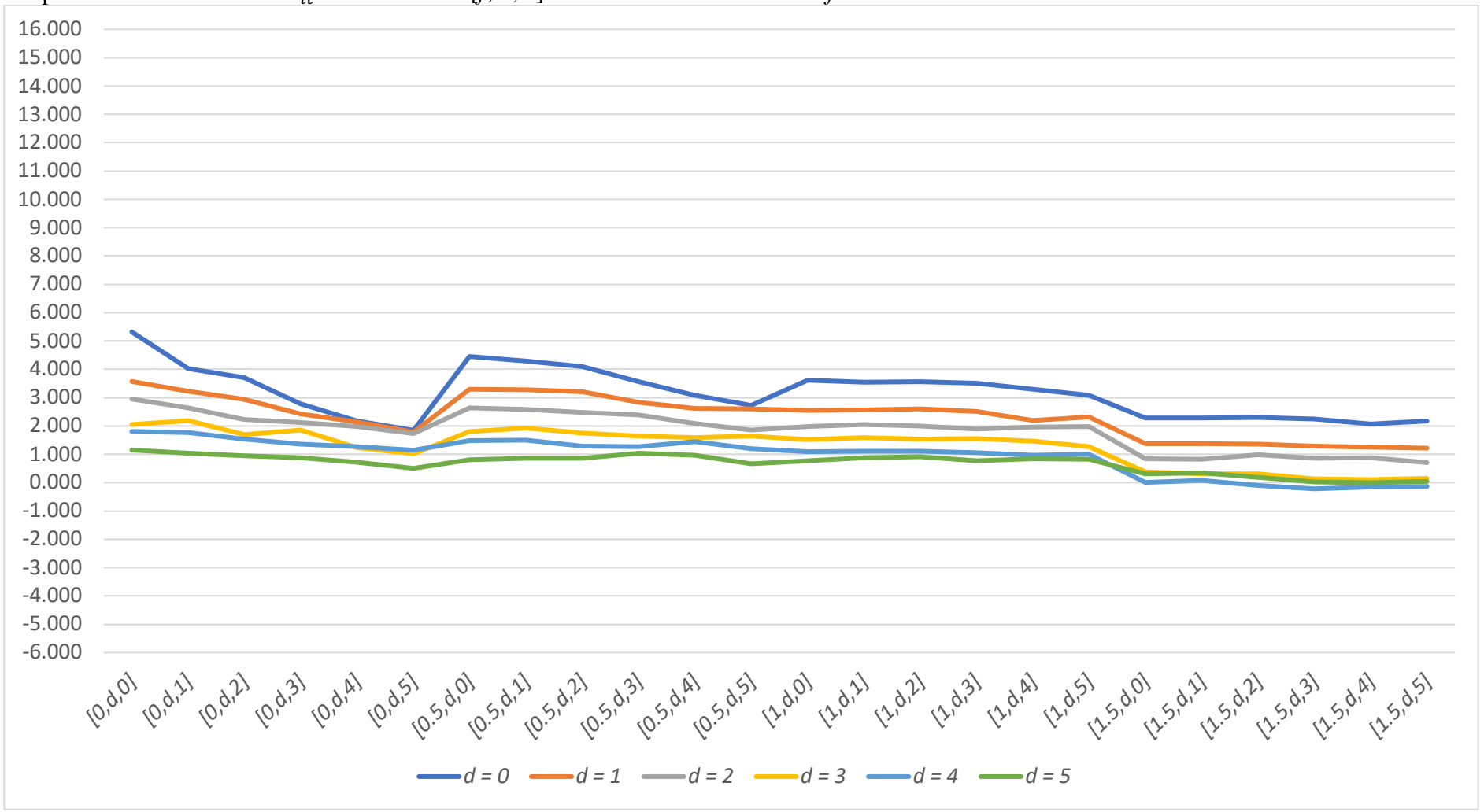
**Appendix 65: EW Developed excl. US S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



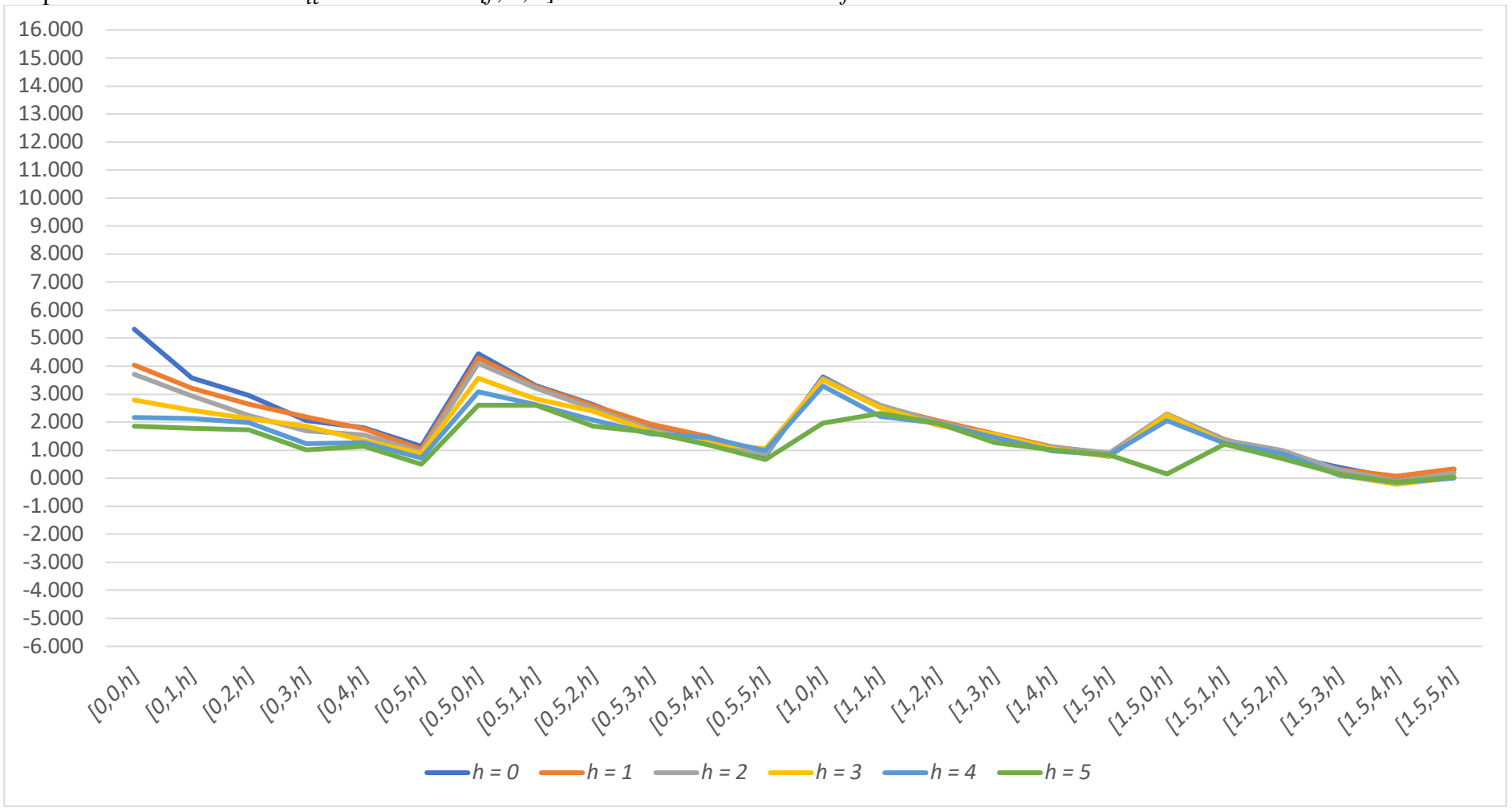
**Appendix 66: EW Developed excl. US S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 67: EW Developed excl. US S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 68: EW Developed excl. US S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.319*** | 4.030*** | 3.699*** | 2.788*** | 2.176** | 1.847** |
| 1 | 3.570*** | 3.216*** | 2.932*** | 2.431*** | 2.138** | 1.791* |
| 2 | 2.950*** | 2.641*** | 2.237** | 2.122** | 1.980** | 1.728* |
| 3 | 2.050** | 2.189** | 1.695* | 1.854** | 1.240 | 1.015 |
| 4 | 1.805* | 1.770* | 1.537 | 1.351 | 1.262 | 1.146 |
| 5 | 1.149 | 1.030 | 0.942 | 0.879 | 0.715 | 0.496 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.447*** | 4.295*** | 4.097*** | 3.568*** | 3.090*** | 2.731*** |
| 1 | 3.300*** | 3.271*** | 3.205*** | 2.835*** | 2.617*** | 2.606*** |
| 2 | 2.630*** | 2.592*** | 2.479*** | 2.396** | 2.080** | 1.857** |
| 3 | 1.794* | 1.928** | 1.745* | 1.649* | 1.581* | 1.640* |
| 4 | 1.485 | 1.493 | 1.279 | 1.266 | 1.452 | 1.198 |
| 5 | 0.803 | 0.868 | 0.859 | 1.044 | 0.969 | 0.661 |

***f = 1***

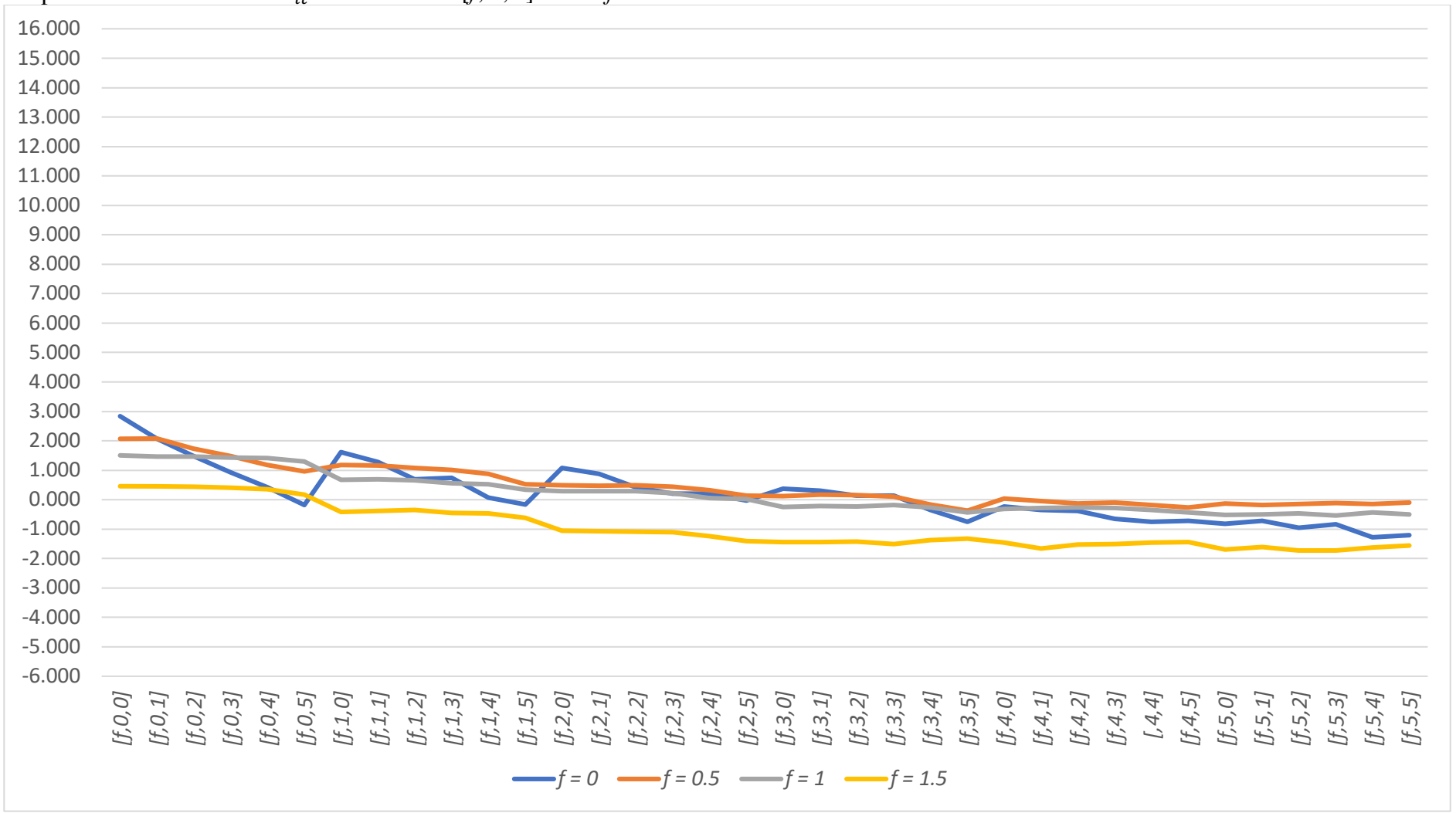
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.618*** | 3.570*** | 3.216*** | 2.932*** | 2.431*** | 2.138** |
| 1 | 2.556*** | 2.562*** | 2.609*** | 2.521*** | 2.197** | 2.312** |
| 2 | 1.979** | 2.052** | 1.995** | 1.888* | 1.966** | 1.971** |
| 3 | 1.517 | 1.582 | 1.531 | 1.559 | 1.459 | 1.277 |
| 4 | 1.089 | 1.115 | 1.101 | 1.056 | 0.968 | 1.010 |
| 5 | 0.772 | 0.876 | 0.906 | 0.778 | 0.835 | 0.825 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.286** | 3.300*** | 3.271*** | 3.205*** | 2.835*** | 2.617*** |
| 1 | 1.371 | 1.370 | 1.364 | 1.278 | 1.248 | 1.216 |
| 2 | 0.843 | 0.824 | 0.987 | 0.862 | 0.882 | 0.707 |
| 3 | 0.380 | 0.312 | 0.301 | 0.122 | 0.105 | 0.149 |
| 4 | -0.001 | 0.073 | -0.109 | -0.220 | -0.154 | -0.140 |
| 5 | 0.303 | 0.339 | 0.188 | 0.024 | -0.004 | 0.042 |

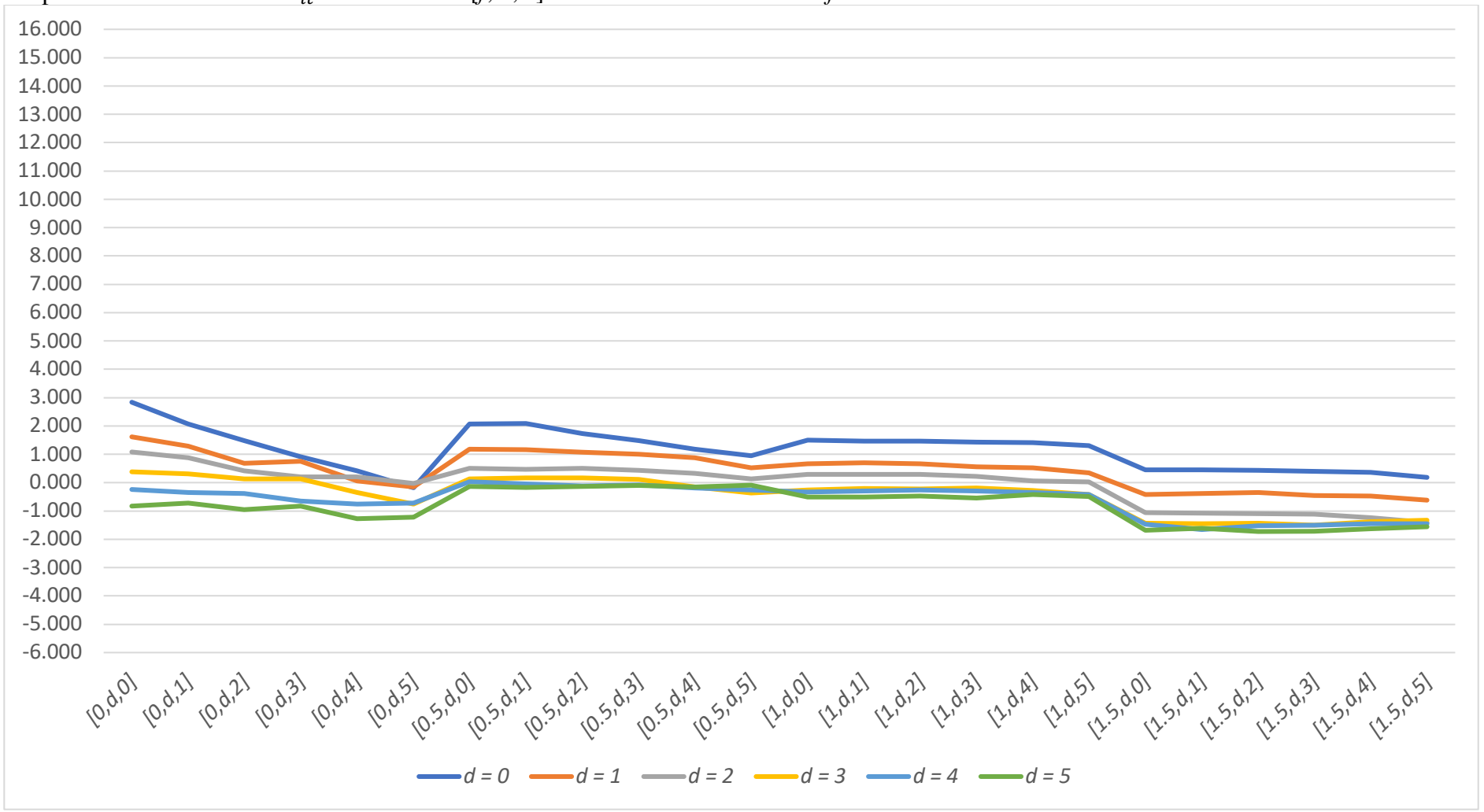
**Appendix 69: EW Developed excl. US S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



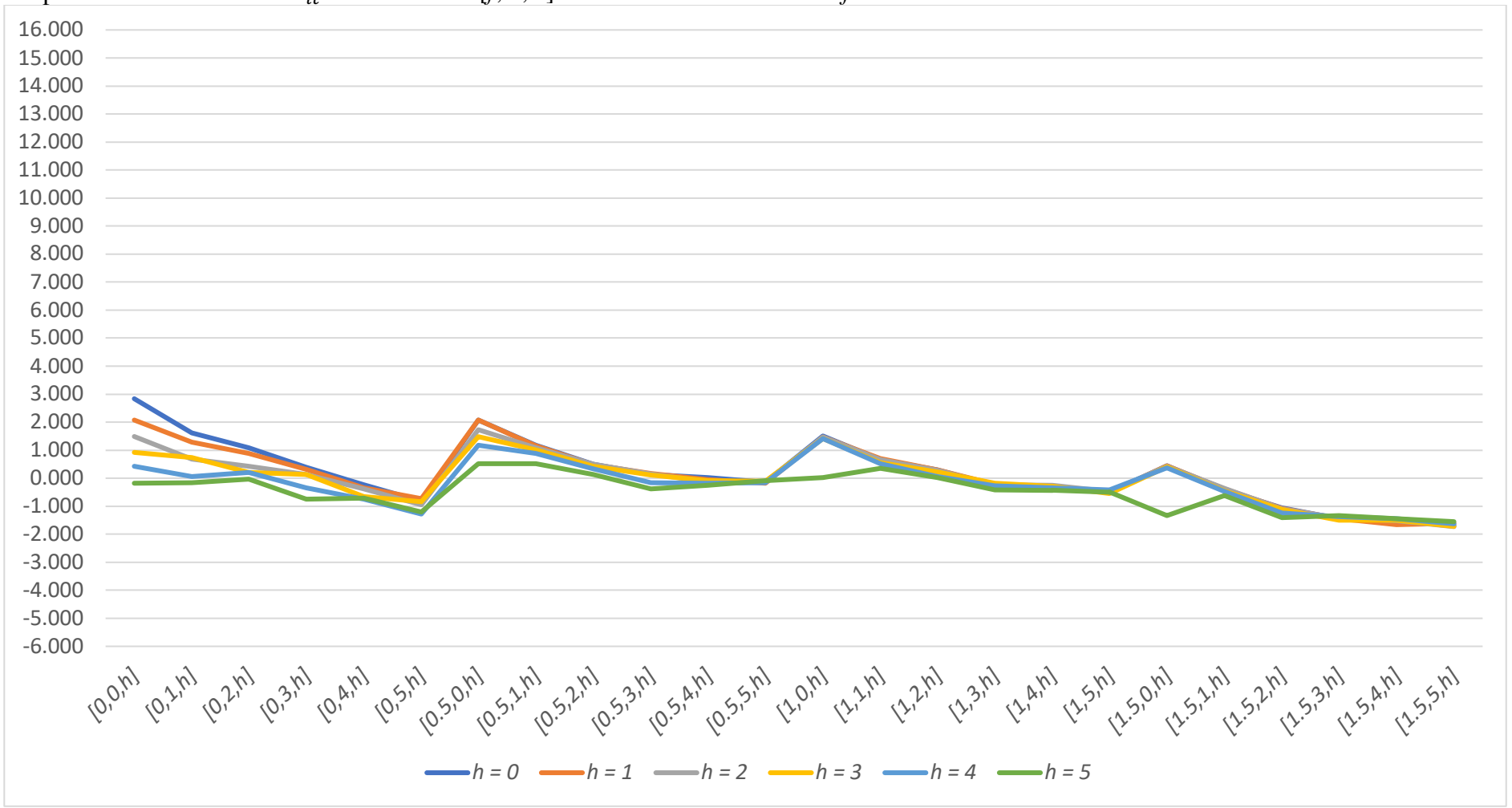
**Appendix 70: EW Developed excl. US S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 71: EW Developed excl. US S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 72: EW Developed excl. US S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.837*** | 2.073*** | 1.484* | 0.919 | 0.421 | -0.182 |
| 1 | 1.615** | 1.286 | 0.688 | 0.744 | 0.063 | -0.160 |
| 2 | 1.081 | 0.883 | 0.422 | 0.201 | 0.199 | -0.031 |
| 3 | 0.381 | 0.314 | 0.131 | 0.132 | -0.348 | -0.752 |
| 4 | -0.240 | -0.353 | -0.377 | -0.658 | -0.756 | -0.719 |
| 5 | -0.821 | -0.727 | -0.953 | -0.832 | -1.278 | -1.213 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.068** | 2.078** | 1.731** | 1.483* | 1.181 | 0.955 |
| 1 | 1.183 | 1.159 | 1.080 | 1.008 | 0.879 | 0.519 |
| 2 | 0.497 | 0.476 | 0.497 | 0.432 | 0.329 | 0.130 |
| 3 | 0.127 | 0.172 | 0.159 | 0.108 | -0.161 | -0.373 |
| 4 | 0.031 | -0.046 | -0.123 | -0.090 | -0.184 | -0.258 |
| 5 | -0.135 | -0.178 | -0.140 | -0.106 | -0.154 | -0.091 |

***f = 1***

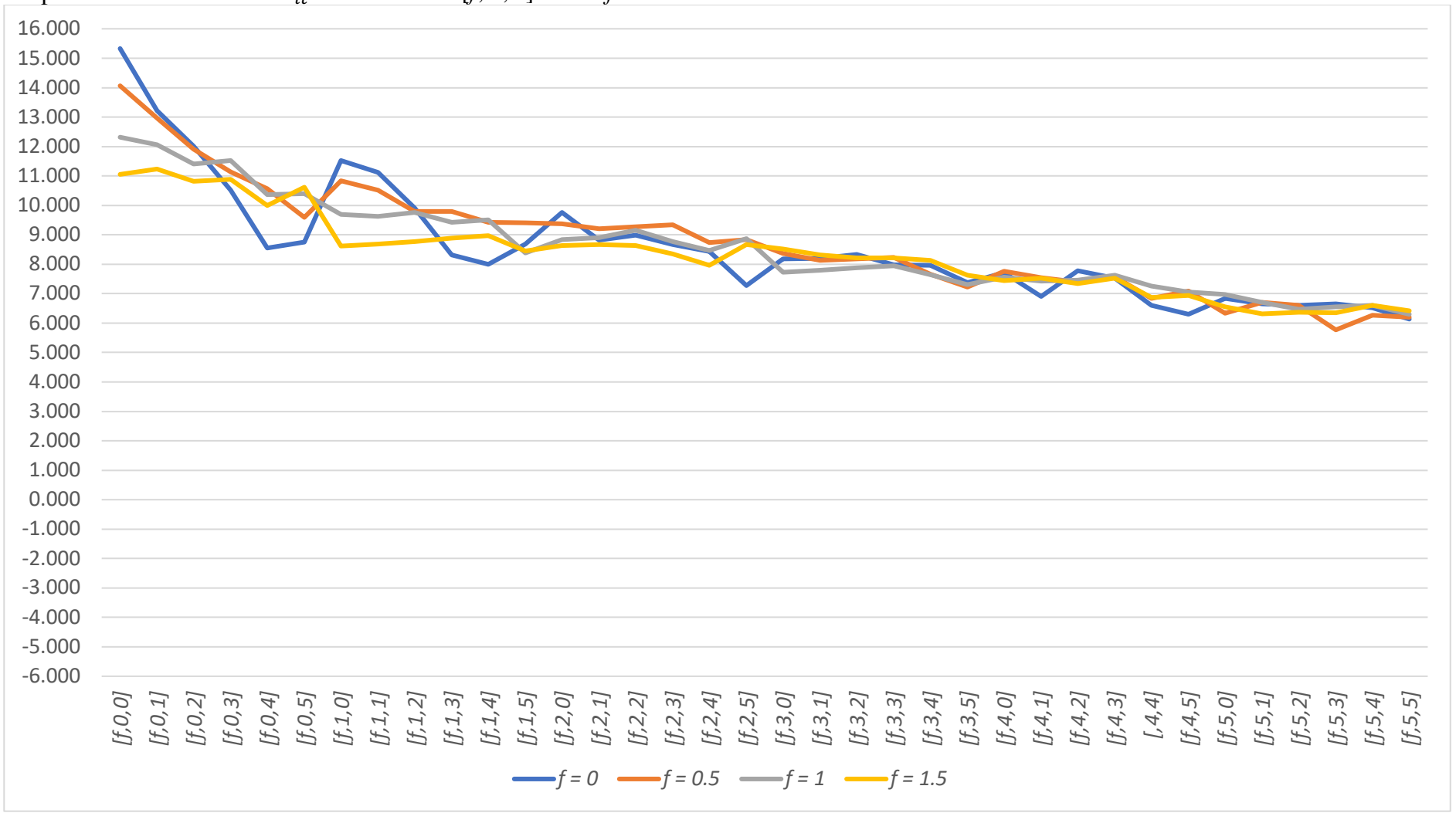
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 1.505* | 1.615** | 1.286 | 0.688 | 0.744 | 0.063 |
| 1 | 0.670 | 0.699 | 0.659 | 0.552 | 0.524 | 0.347 |
| 2 | 0.289 | 0.293 | 0.284 | 0.218 | 0.057 | 0.021 |
| 3 | -0.253 | -0.212 | -0.227 | -0.181 | -0.271 | -0.426 |
| 4 | -0.324 | -0.288 | -0.259 | -0.288 | -0.346 | -0.428 |
| 5 | -0.518 | -0.505 | -0.470 | -0.538 | -0.425 | -0.500 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0.451 | 1.183 | 1.159 | 1.080 | 1.008 | 0.879 |
| 1 | -0.414 | -0.385 | -0.357 | -0.451 | -0.466 | -0.620 |
| 2 | -1.055 | -1.078 | -1.094 | -1.106 | -1.245 | -1.408* |
| 3 | -1.438* | -1.447* | -1.430* | -1.502* | -1.377* | -1.328 |
| 4 | -1.462* | -1.658** | -1.522* | -1.507* | -1.453* | -1.447* |
| 5 | -1.687** | -1.609** | -1.727** | -1.719** | -1.628** | -1.550* |

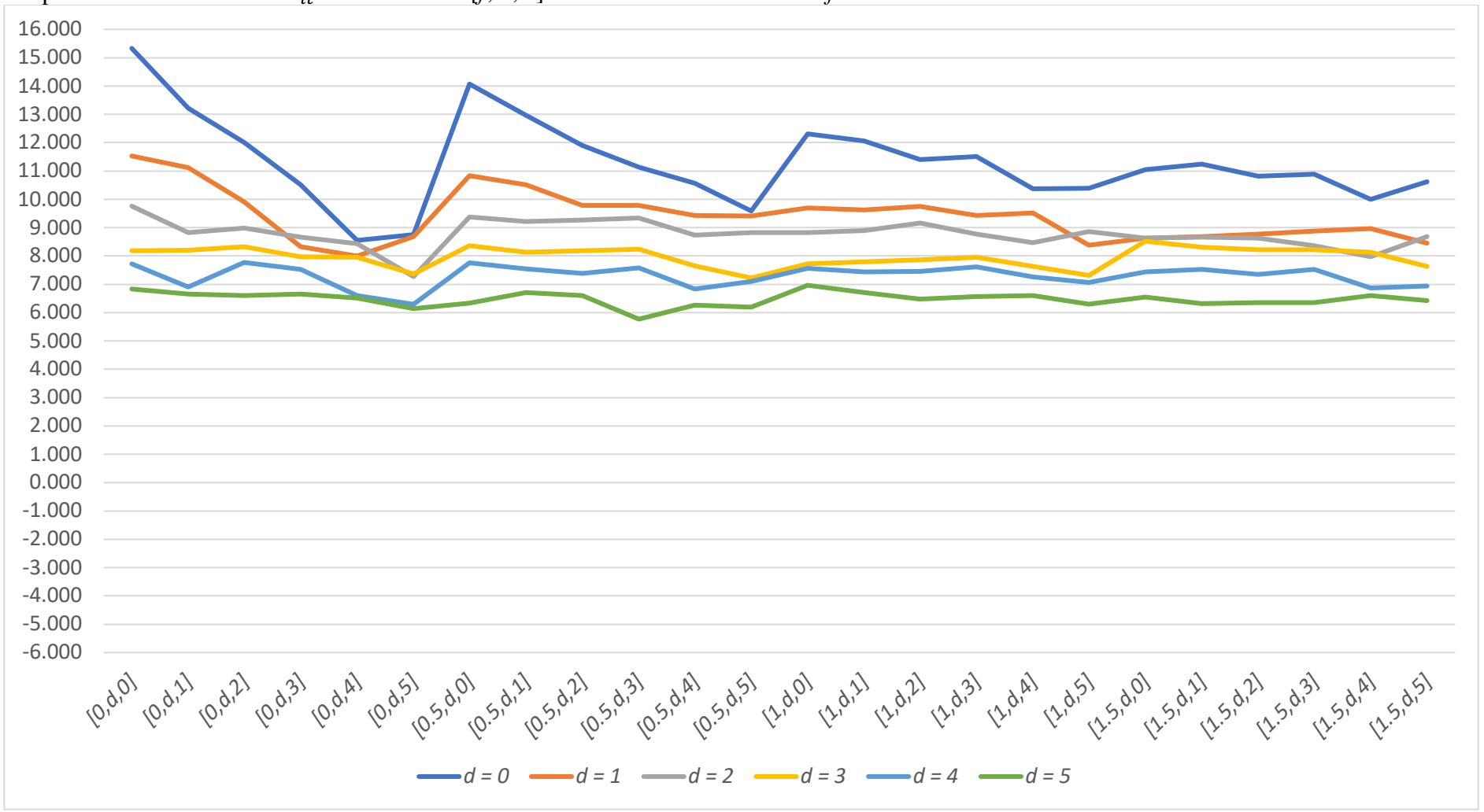
**Appendix 73: VW Japan S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



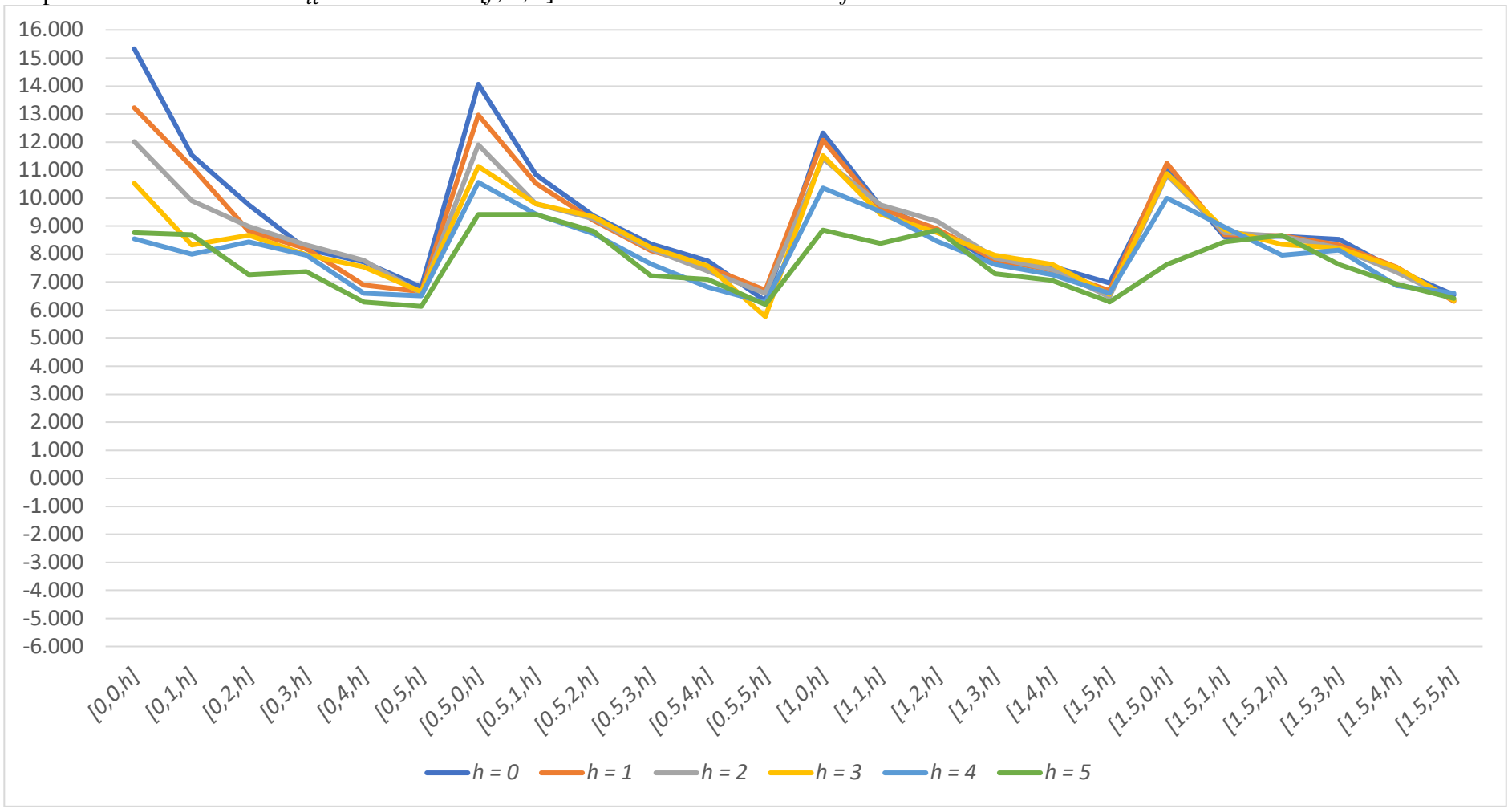
**Appendix 74: VW Japan S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 75: VW Japan S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 76: VW Japan S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 15.329*** | 13.225*** | 12.014*** | 10.522*** | 8.550*** | 8.760*** |
| 1 | 11.529*** | 11.115*** | 9.909*** | 8.321*** | 7.997*** | 8.688*** |
| 2 | 9.759*** | 8.819*** | 8.989*** | 8.668*** | 8.431*** | 7.272*** |
| 3 | 8.181*** | 8.205*** | 8.325*** | 7.979*** | 7.962*** | 7.368*** |
| 4 | 7.715*** | 6.900*** | 7.772*** | 7.532*** | 6.600*** | 6.294*** |
| 5 | 6.830*** | 6.661*** | 6.609*** | 6.659*** | 6.518*** | 6.136*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.063*** | 12.969*** | 11.904*** | 11.134*** | 10.561*** | 9.596*** |
| 1 | 10.832*** | 10.518*** | 9.792*** | 9.793*** | 9.425*** | 9.414*** |
| 2 | 9.380*** | 9.211*** | 9.267*** | 9.342*** | 8.737*** | 8.831*** |
| 3 | 8.362*** | 8.127*** | 8.178*** | 8.237*** | 7.657*** | 7.223*** |
| 4 | 7.763*** | 7.543*** | 7.387*** | 7.578*** | 6.830*** | 7.098*** |
| 5 | 6.335*** | 6.705*** | 6.600*** | 5.770*** | 6.273*** | 6.198*** |

***f = 1***

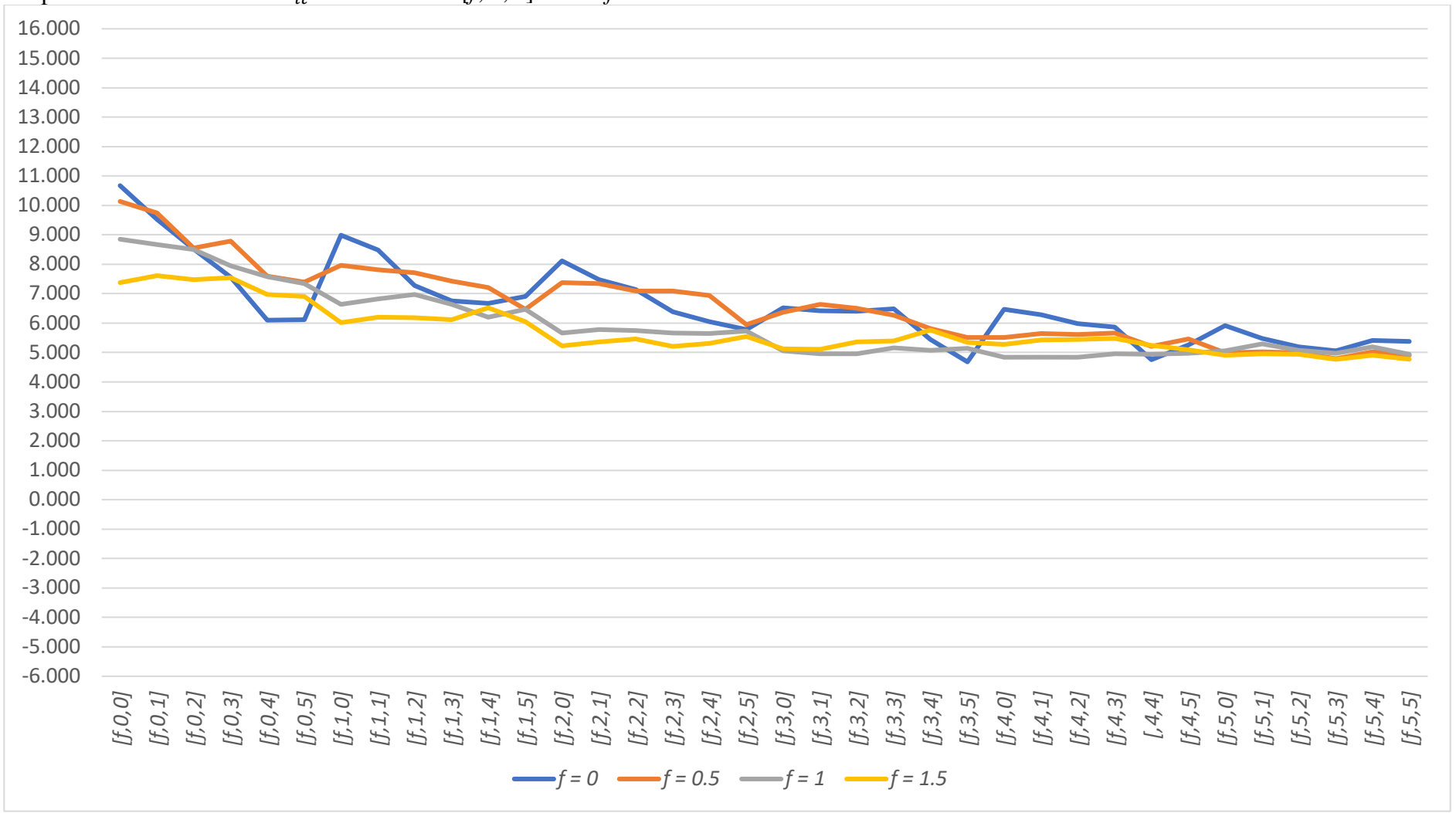
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.316*** | 11.529*** | 11.115*** | 9.909*** | 8.321*** | 7.997*** |
| 1 | 9.699*** | 9.620*** | 9.753*** | 9.425*** | 9.512*** | 8.387*** |
| 2 | 8.829*** | 8.900*** | 9.163*** | 8.775*** | 8.461*** | 8.864*** |
| 3 | 7.721*** | 7.792*** | 7.872*** | 7.954*** | 7.639*** | 7.306*** |
| 4 | 7.557*** | 7.433*** | 7.453*** | 7.622*** | 7.266*** | 7.058*** |
| 5 | 6.966*** | 6.702*** | 6.471*** | 6.559*** | 6.602*** | 6.299*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.053*** | 10.832*** | 10.518*** | 9.792*** | 9.793*** | 9.425*** |
| 1 | 8.626*** | 8.689*** | 8.773*** | 8.882*** | 8.972*** | 8.444*** |
| 2 | 8.636*** | 8.666*** | 8.636*** | 8.354*** | 7.965*** | 8.675*** |
| 3 | 8.522*** | 8.318*** | 8.212*** | 8.223*** | 8.139*** | 7.626*** |
| 4 | 7.435*** | 7.532*** | 7.349*** | 7.519*** | 6.876*** | 6.942*** |
| 5 | 6.555*** | 6.314*** | 6.362*** | 6.355*** | 6.603*** | 6.422*** |

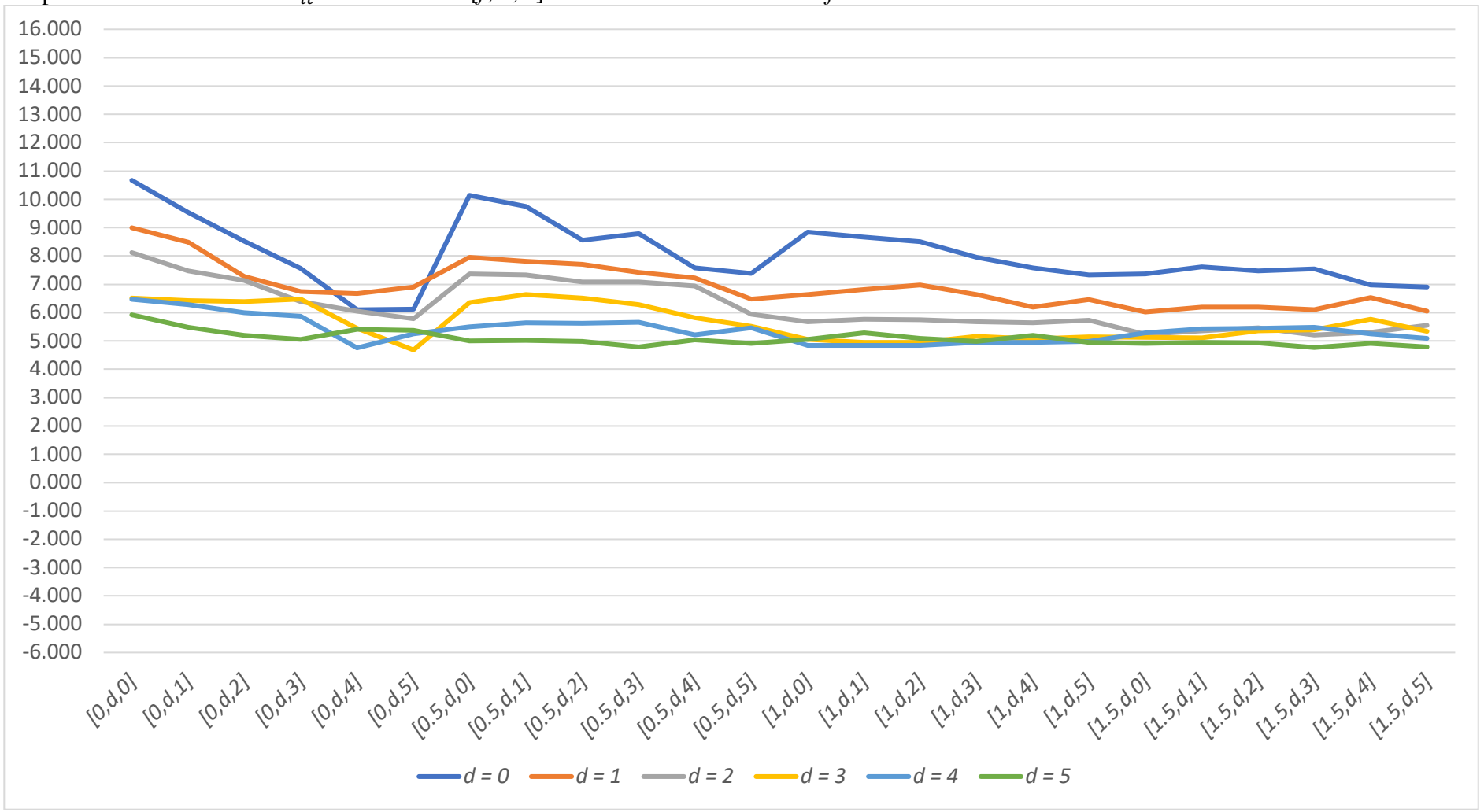
**Appendix 77: VW Japan S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



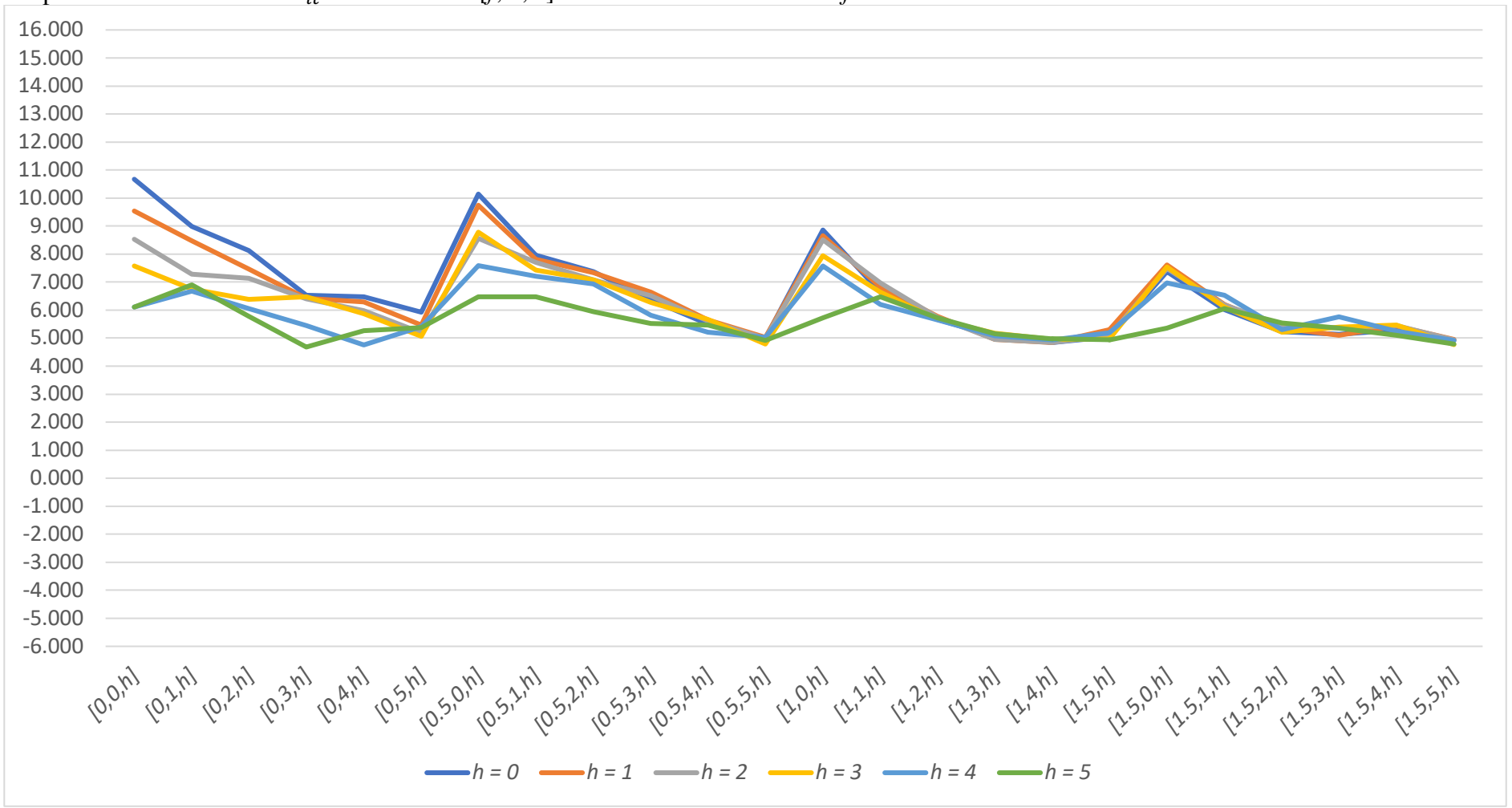
**Appendix 78: VW Japan S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 79: VW Japan S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 80: VW Japan S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.671*** | 9.528*** | 8.522*** | 7.567*** | 6.101*** | 6.114*** |
| 1 | 8.996*** | 8.480*** | 7.276*** | 6.747*** | 6.676*** | 6.901*** |
| 2 | 8.120*** | 7.469*** | 7.133*** | 6.381*** | 6.046*** | 5.776*** |
| 3 | 6.522*** | 6.419*** | 6.395*** | 6.483*** | 5.444*** | 4.682*** |
| 4 | 6.469*** | 6.285*** | 5.989*** | 5.872*** | 4.756*** | 5.258*** |
| 5 | 5.923*** | 5.475*** | 5.198*** | 5.060*** | 5.410*** | 5.370*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.134*** | 9.743*** | 8.559*** | 8.781*** | 7.588*** | 7.391*** |
| 1 | 7.959*** | 7.805*** | 7.709*** | 7.427*** | 7.216*** | 6.470*** |
| 2 | 7.372*** | 7.338*** | 7.089*** | 7.088*** | 6.936*** | 5.948*** |
| 3 | 6.360*** | 6.638*** | 6.505*** | 6.274*** | 5.822*** | 5.514*** |
| 4 | 5.507*** | 5.643*** | 5.620*** | 5.664*** | 5.211*** | 5.468*** |
| 5 | 4.996*** | 5.019*** | 4.987*** | 4.791*** | 5.030*** | 4.908*** |

***f = 1***

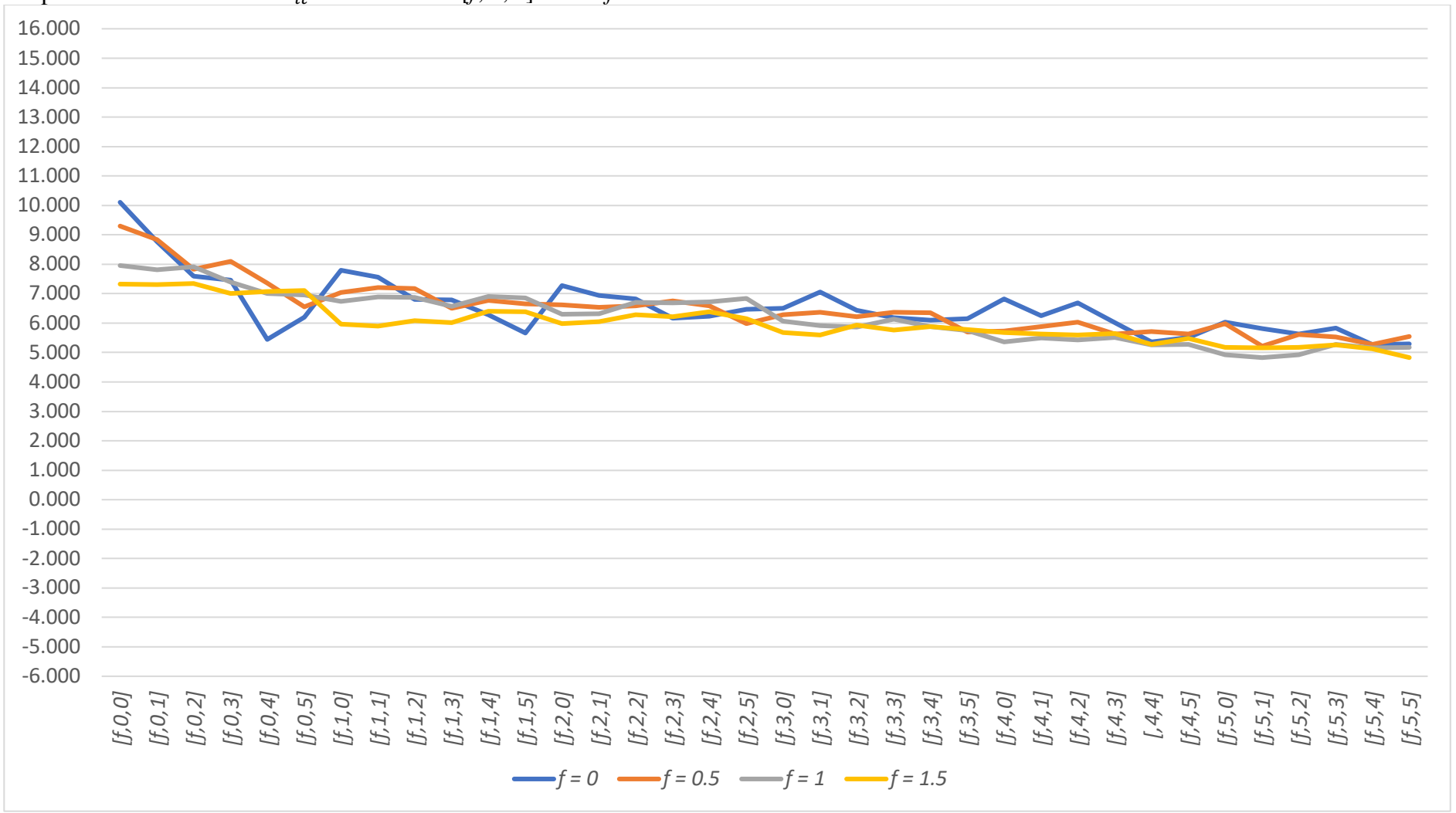
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.850*** | 8.996*** | 8.480*** | 7.276*** | 6.747*** | 6.676*** |
| 1 | 6.636*** | 6.821*** | 6.970*** | 6.640*** | 6.195*** | 6.467*** |
| 2 | 5.669*** | 5.773*** | 5.749*** | 5.669*** | 5.650*** | 5.723*** |
| 3 | 5.055*** | 4.956*** | 4.952*** | 5.165*** | 5.077*** | 5.150*** |
| 4 | 4.843*** | 4.842*** | 4.846*** | 4.956*** | 4.942*** | 4.980*** |
| 5 | 5.051*** | 5.293*** | 5.083*** | 4.976*** | 5.191*** | 4.942*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.370*** | 7.959*** | 7.805*** | 7.709*** | 7.427*** | 7.216*** |
| 1 | 6.022*** | 6.201*** | 6.186*** | 6.108*** | 6.524*** | 6.055*** |
| 2 | 5.234*** | 5.356*** | 5.460*** | 5.210*** | 5.311*** | 5.545*** |
| 3 | 5.131*** | 5.104*** | 5.355*** | 5.391*** | 5.762*** | 5.348*** |
| 4 | 5.280*** | 5.429*** | 5.442*** | 5.474*** | 5.250*** | 5.094*** |
| 5 | 4.909*** | 4.957*** | 4.933*** | 4.768*** | 4.910*** | 4.781*** |

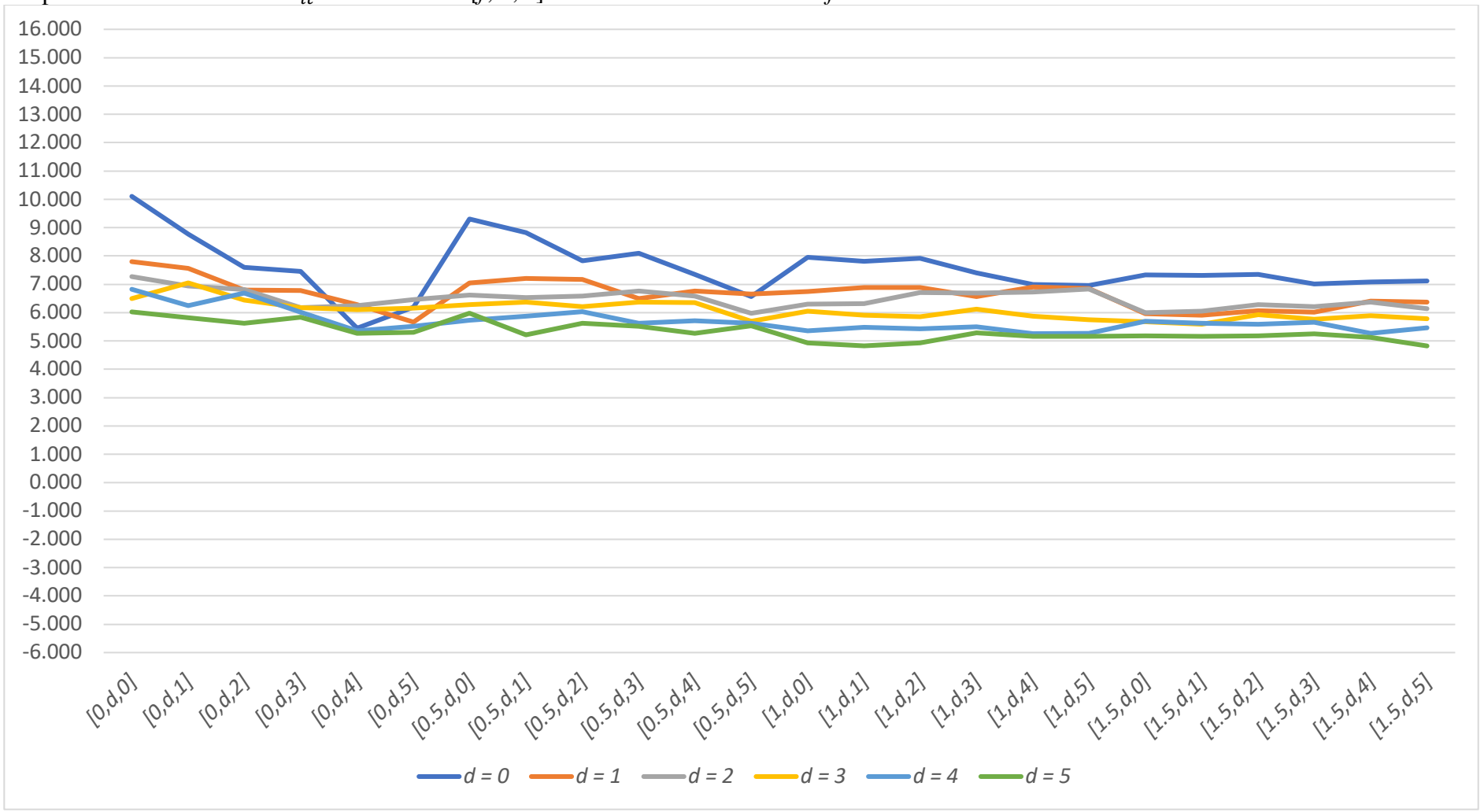
**Appendix 81: VW Japan S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



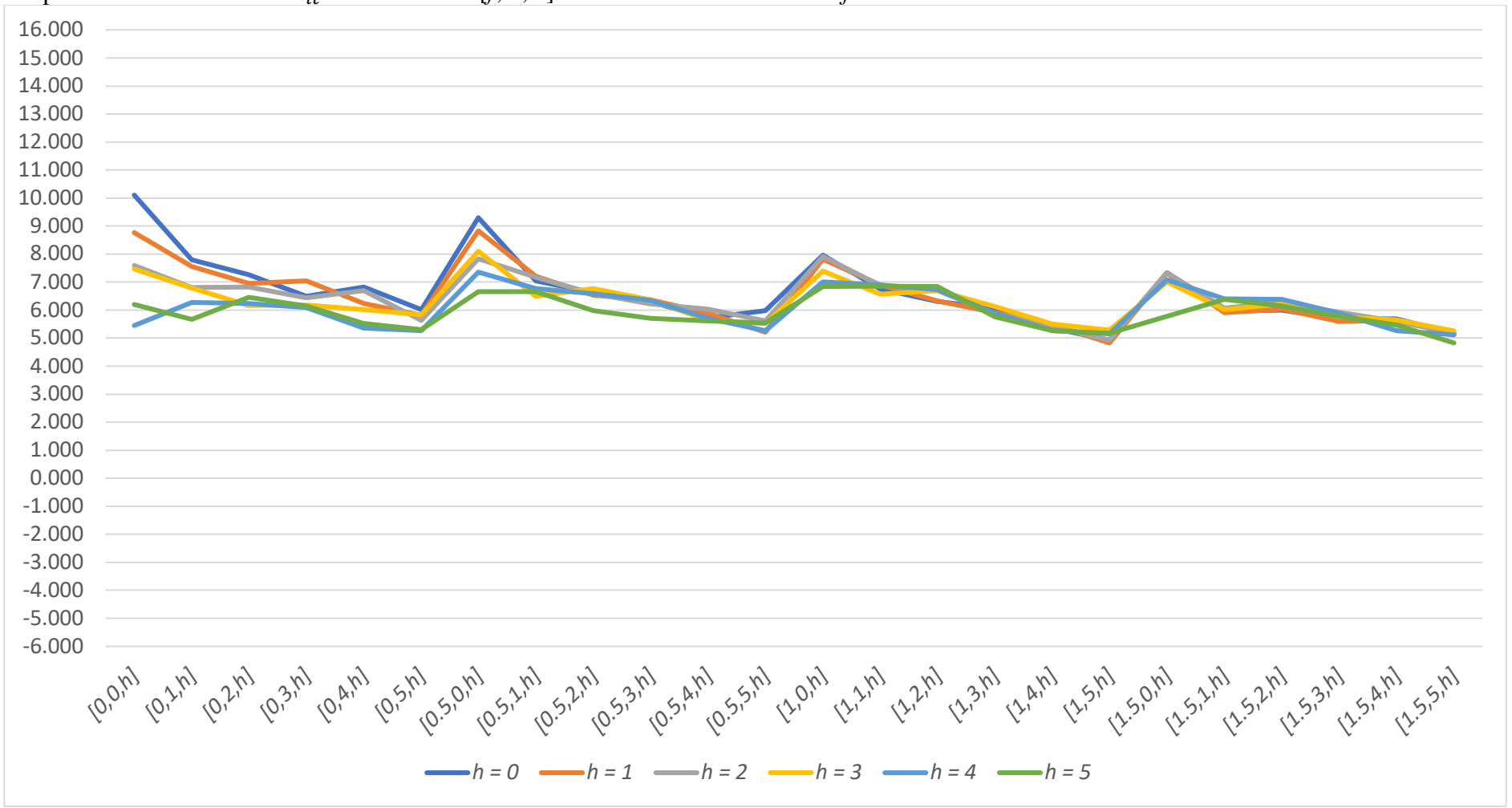
**Appendix 82: VW Japan S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 83: VW Japan S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 84: VW Japan S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.105*** | 8.775*** | 7.595*** | 7.464*** | 5.451*** | 6.200*** |
| 1 | 7.800*** | 7.564*** | 6.797*** | 6.789*** | 6.276*** | 5.666*** |
| 2 | 7.272*** | 6.943*** | 6.821*** | 6.169*** | 6.241*** | 6.466*** |
| 3 | 6.495*** | 7.050*** | 6.440*** | 6.182*** | 6.096*** | 6.152*** |
| 4 | 6.824*** | 6.245*** | 6.688*** | 6.018*** | 5.361*** | 5.514*** |
| 5 | 6.026*** | 5.815*** | 5.626*** | 5.831*** | 5.269*** | 5.298*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.297*** | 8.831*** | 7.832*** | 8.098*** | 7.354*** | 6.561*** |
| 1 | 7.042*** | 7.203*** | 7.176*** | 6.495*** | 6.769*** | 6.660*** |
| 2 | 6.626*** | 6.533*** | 6.591*** | 6.760*** | 6.585*** | 5.976*** |
| 3 | 6.284*** | 6.372*** | 6.214*** | 6.371*** | 6.354*** | 5.703*** |
| 4 | 5.732*** | 5.881*** | 6.039*** | 5.624*** | 5.707*** | 5.622*** |
| 5 | 5.976*** | 5.216*** | 5.616*** | 5.521*** | 5.269*** | 5.544*** |

***f = 1***

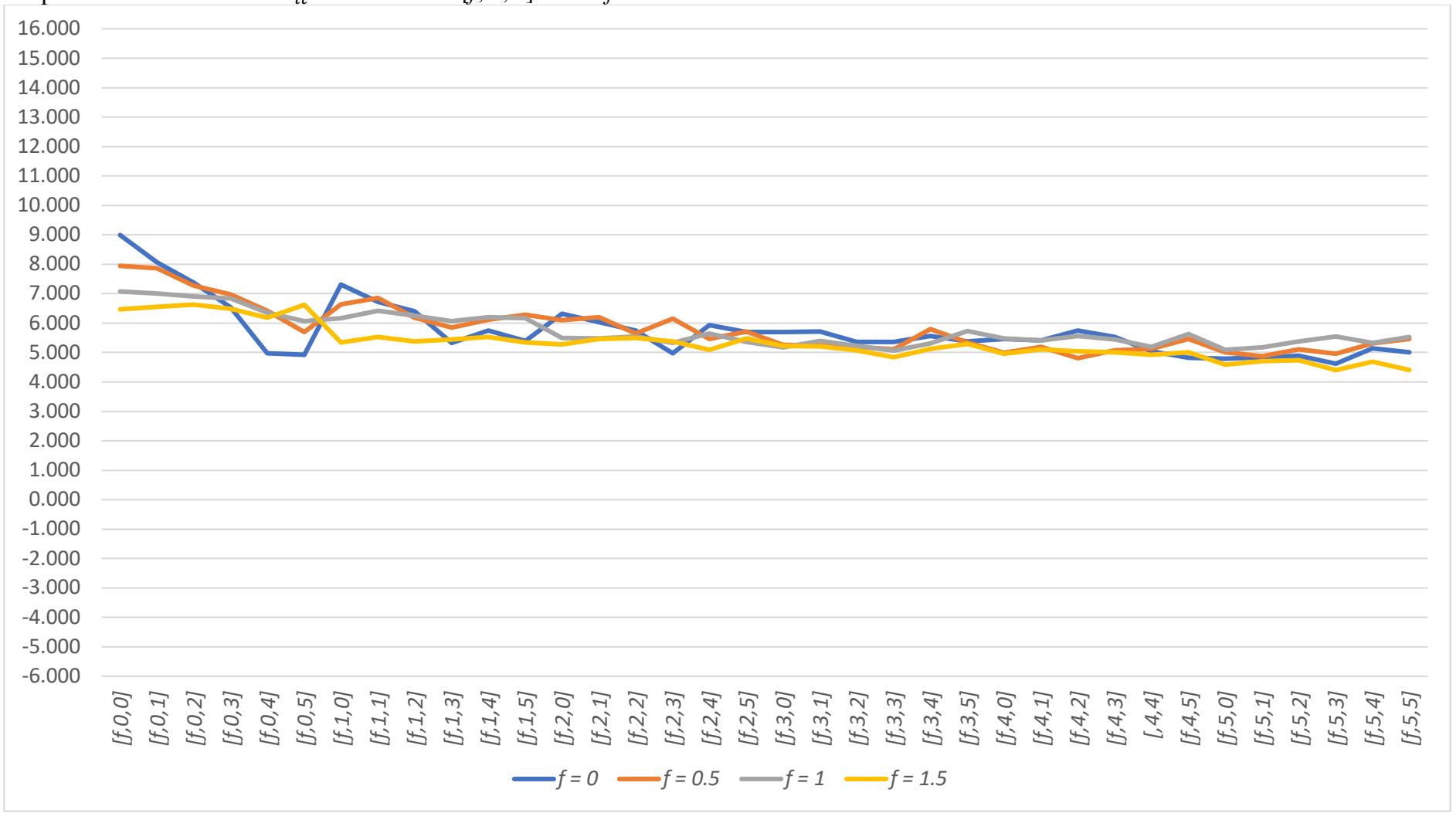
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.956*** | 7.800*** | 7.564*** | 6.797*** | 6.789*** | 6.276*** |
| 1 | 6.742*** | 6.890*** | 6.880*** | 6.568*** | 6.904*** | 6.854*** |
| 2 | 6.309*** | 6.323*** | 6.702*** | 6.695*** | 6.725*** | 6.842*** |
| 3 | 6.059*** | 5.913*** | 5.863*** | 6.127*** | 5.881*** | 5.753*** |
| 4 | 5.360*** | 5.487*** | 5.428*** | 5.507*** | 5.258*** | 5.269*** |
| 5 | 4.930*** | 4.827*** | 4.926*** | 5.284*** | 5.154*** | 5.170*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.331*** | 7.042*** | 7.203*** | 7.176*** | 6.495*** | 6.769*** |
| 1 | 5.970*** | 5.904*** | 6.076*** | 6.009*** | 6.408*** | 6.379*** |
| 2 | 5.990*** | 6.044*** | 6.279*** | 6.212*** | 6.377*** | 6.149*** |
| 3 | 5.679*** | 5.591*** | 5.934*** | 5.767*** | 5.886*** | 5.787*** |
| 4 | 5.687*** | 5.625*** | 5.597*** | 5.654*** | 5.271*** | 5.470*** |
| 5 | 5.174*** | 5.159*** | 5.172*** | 5.259*** | 5.118*** | 4.828*** |

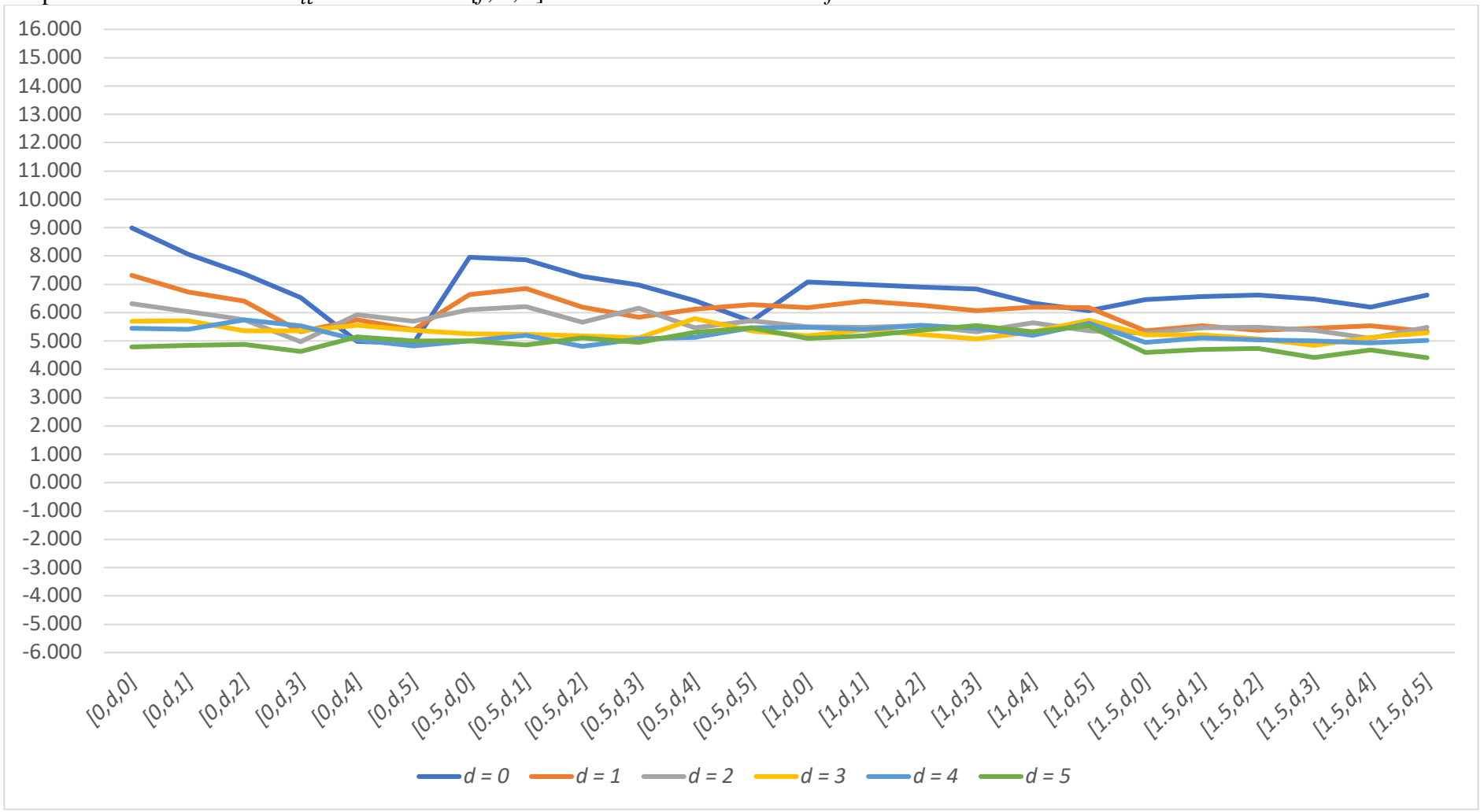
**Appendix 85: VW Japan S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



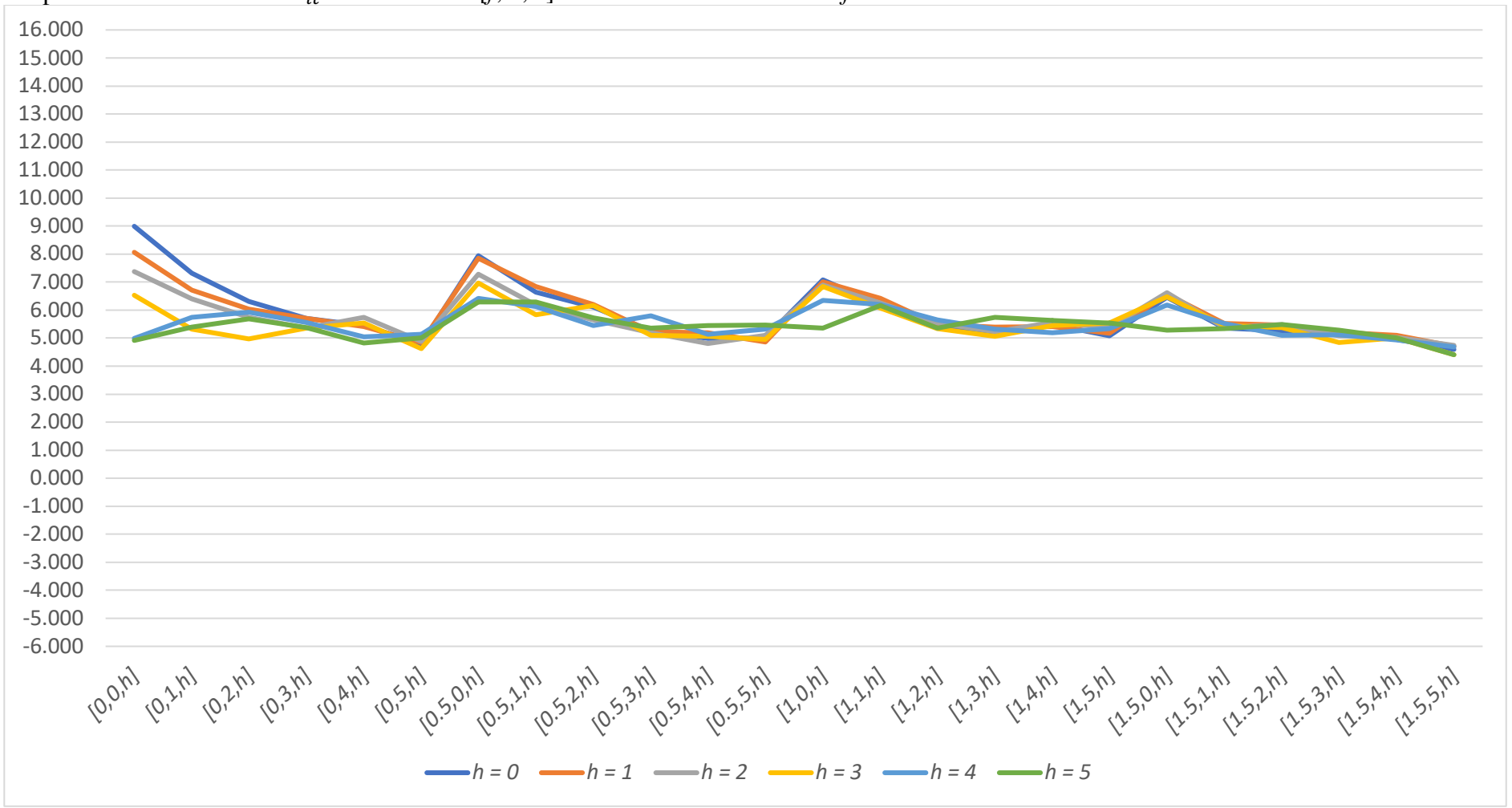
**Appendix 86: VW Japan S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 87: VW Japan S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 88: VW Japan S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.992*** | 8.063*** | 7.375*** | 6.538*** | 4.982*** | 4.918*** |
| 1 | 7.316*** | 6.720*** | 6.410*** | 5.326*** | 5.745*** | 5.386*** |
| 2 | 6.315*** | 6.040*** | 5.745*** | 4.973*** | 5.932*** | 5.691*** |
| 3 | 5.703*** | 5.712*** | 5.356*** | 5.359*** | 5.559*** | 5.381*** |
| 4 | 5.453*** | 5.405*** | 5.744*** | 5.536*** | 5.045*** | 4.819*** |
| 5 | 4.794*** | 4.843*** | 4.886*** | 4.620*** | 5.145*** | 5.011*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.945*** | 7.857*** | 7.282*** | 6.967*** | 6.419*** | 5.703*** |
| 1 | 6.645*** | 6.849*** | 6.188*** | 5.840*** | 6.122*** | 6.290*** |
| 2 | 6.106*** | 6.205*** | 5.652*** | 6.158*** | 5.457*** | 5.715*** |
| 3 | 5.260*** | 5.236*** | 5.186*** | 5.103*** | 5.790*** | 5.349*** |
| 4 | 4.994*** | 5.199*** | 4.808*** | 5.072*** | 5.132*** | 5.457*** |
| 5 | 5.006*** | 4.867*** | 5.103*** | 4.954*** | 5.312*** | 5.467*** |

***f = 1***

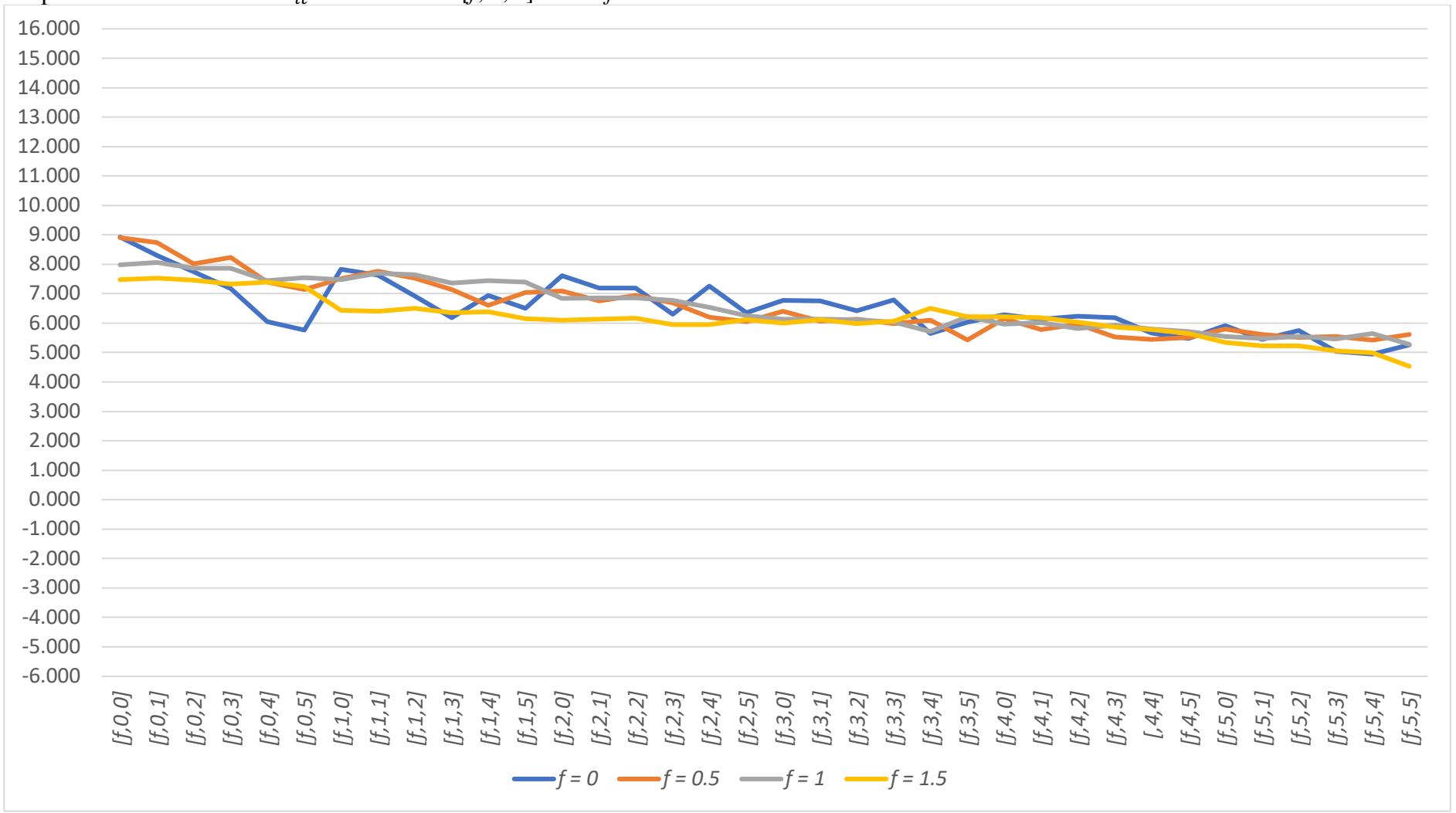
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.075*** | 7.316*** | 6.720*** | 6.410*** | 5.326*** | 5.745*** |
| 1 | 6.174*** | 6.413*** | 6.257*** | 6.069*** | 6.195*** | 6.171*** |
| 2 | 5.499*** | 5.485*** | 5.542*** | 5.330*** | 5.651*** | 5.363*** |
| 3 | 5.182*** | 5.387*** | 5.230*** | 5.067*** | 5.318*** | 5.734*** |
| 4 | 5.482*** | 5.412*** | 5.554*** | 5.441*** | 5.195*** | 5.631*** |
| 5 | 5.085*** | 5.182*** | 5.374*** | 5.542*** | 5.331*** | 5.536*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.466*** | 6.645*** | 6.849*** | 6.188*** | 5.840*** | 6.122*** |
| 1 | 5.350*** | 5.530*** | 5.384*** | 5.452*** | 5.530*** | 5.340*** |
| 2 | 5.273*** | 5.463*** | 5.489*** | 5.373*** | 5.092*** | 5.477*** |
| 3 | 5.222*** | 5.210*** | 5.082*** | 4.843*** | 5.122*** | 5.292*** |
| 4 | 4.952*** | 5.102*** | 5.035*** | 5.001*** | 4.932*** | 5.013*** |
| 5 | 4.596*** | 4.708*** | 4.742*** | 4.409*** | 4.687*** | 4.408*** |

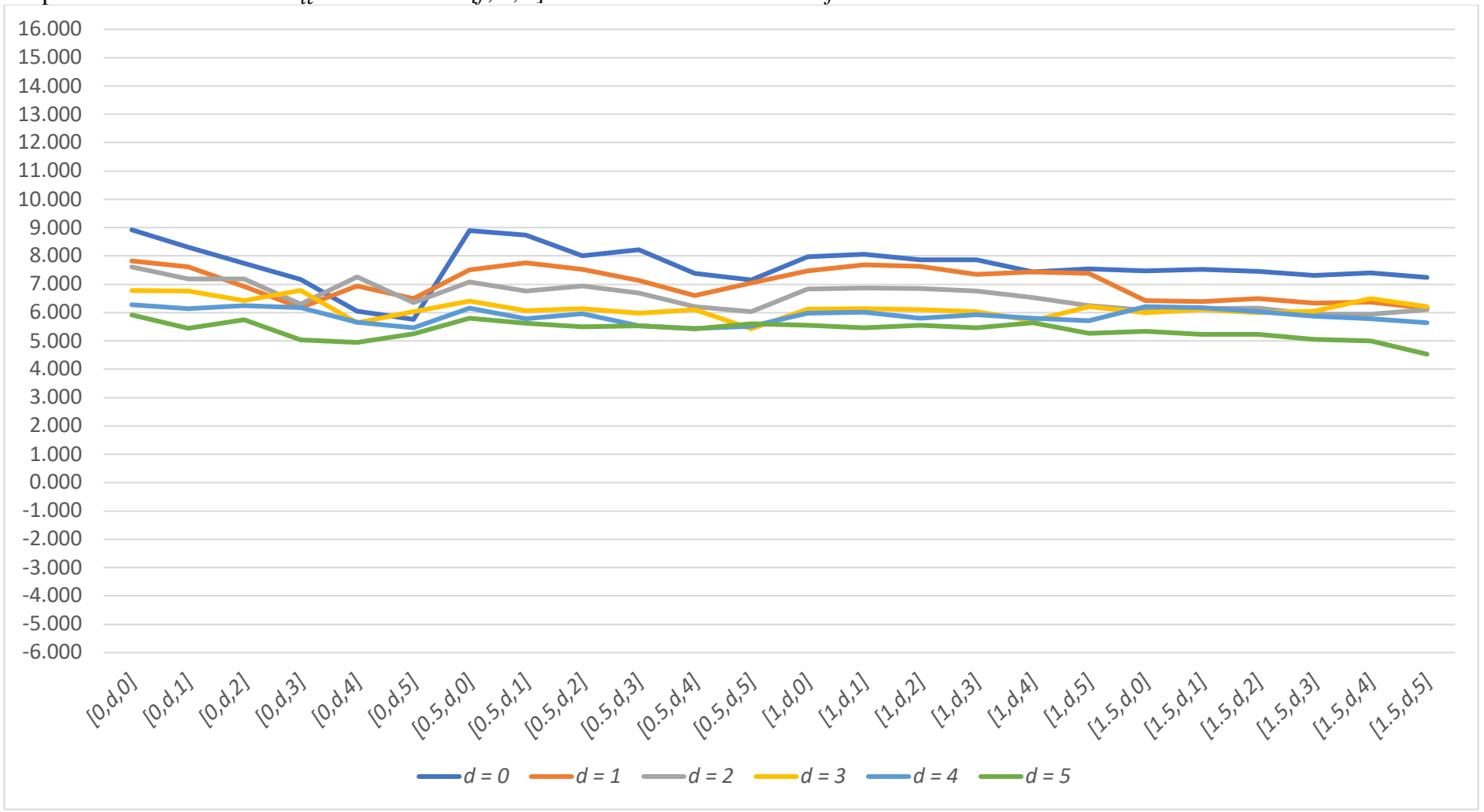
**Appendix 89: VW Japan S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



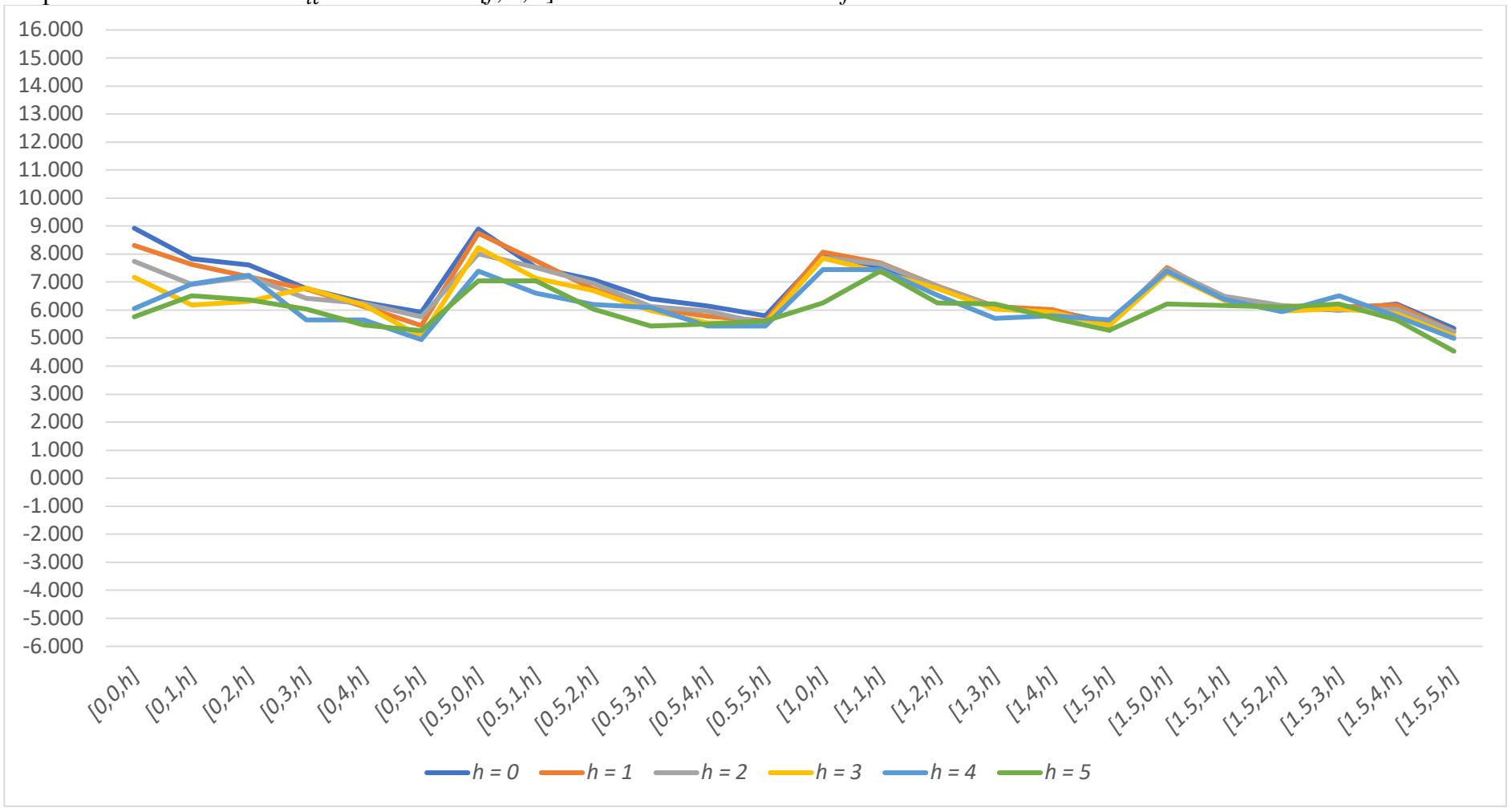
**Appendix 90: VW Japan S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 91: VW Japan S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 92: VW Japan S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.923*** | 8.306*** | 7.742*** | 7.177*** | 6.047*** | 5.761*** |
| 1 | 7.823*** | 7.623*** | 6.921*** | 6.179*** | 6.939*** | 6.503*** |
| 2 | 7.613*** | 7.189*** | 7.194*** | 6.304*** | 7.254*** | 6.358*** |
| 3 | 6.777*** | 6.754*** | 6.416*** | 6.783*** | 5.646*** | 6.030*** |
| 4 | 6.278*** | 6.133*** | 6.239*** | 6.176*** | 5.658*** | 5.471*** |
| 5 | 5.919*** | 5.448*** | 5.754*** | 5.046*** | 4.945*** | 5.259*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.902*** | 8.742*** | 8.010*** | 8.227*** | 7.392*** | 7.146*** |
| 1 | 7.512*** | 7.764*** | 7.526*** | 7.143*** | 6.604*** | 7.043*** |
| 2 | 7.087*** | 6.755*** | 6.943*** | 6.695*** | 6.203*** | 6.042*** |
| 3 | 6.405*** | 6.065*** | 6.134*** | 5.988*** | 6.099*** | 5.429*** |
| 4 | 6.152*** | 5.785*** | 5.957*** | 5.533*** | 5.439*** | 5.510*** |
| 5 | 5.800*** | 5.618*** | 5.504*** | 5.538*** | 5.422*** | 5.615*** |

***f = 1***

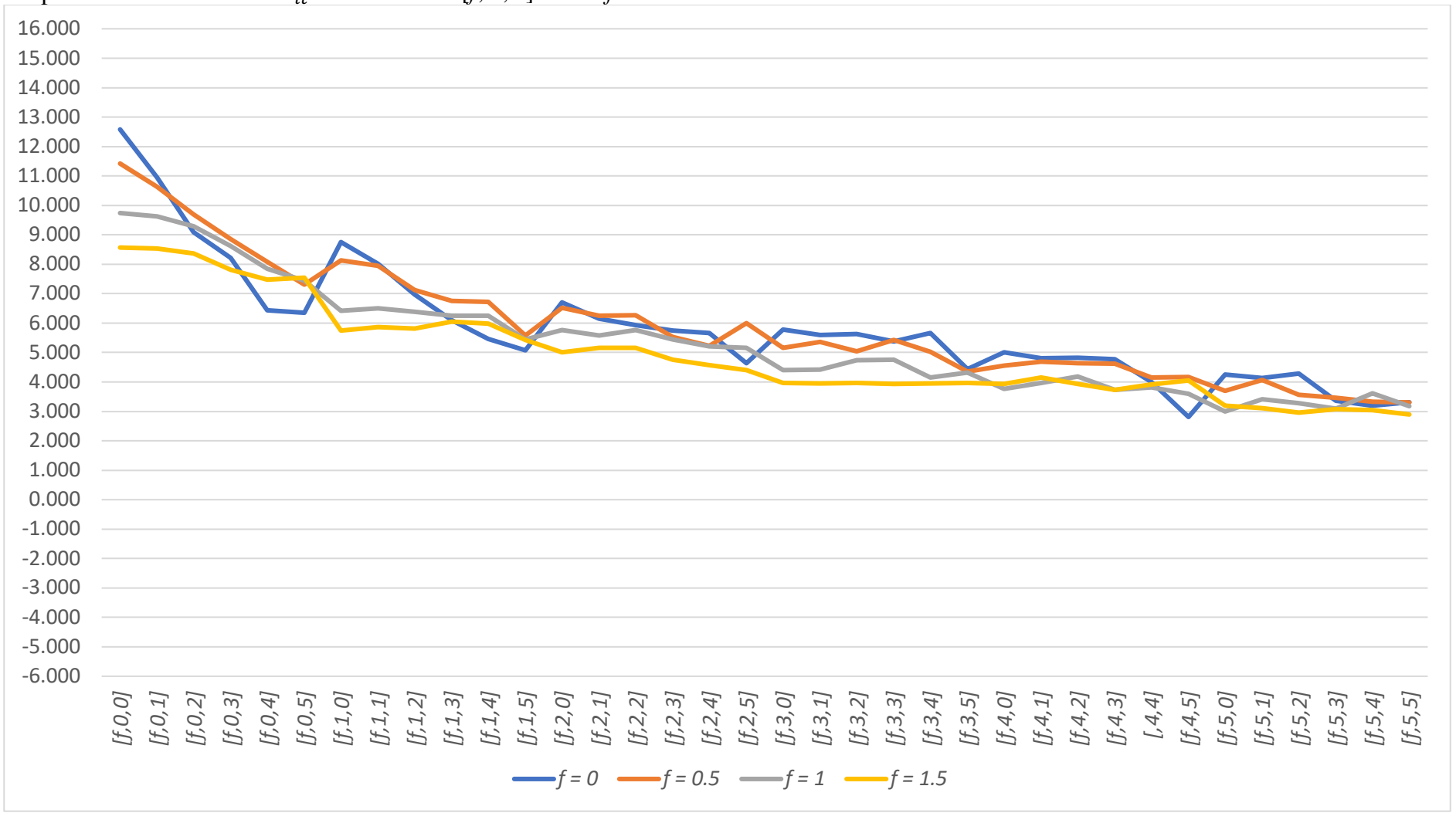
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.976*** | 7.823*** | 7.623*** | 6.921*** | 6.179*** | 6.939*** |
| 1 | 7.477*** | 7.694*** | 7.640*** | 7.356*** | 7.442*** | 7.393*** |
| 2 | 6.837*** | 6.862*** | 6.850*** | 6.767*** | 6.534*** | 6.248*** |
| 3 | 6.127*** | 6.133*** | 6.113*** | 6.040*** | 5.711*** | 6.210*** |
| 4 | 5.972*** | 6.023*** | 5.810*** | 5.925*** | 5.802*** | 5.715*** |
| 5 | 5.552*** | 5.471*** | 5.548*** | 5.457*** | 5.651*** | 5.277*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.476*** | 7.512*** | 7.764*** | 7.526*** | 7.143*** | 6.604*** |
| 1 | 6.427*** | 6.396*** | 6.501*** | 6.344*** | 6.377*** | 6.156*** |
| 2 | 6.092*** | 6.138*** | 6.160*** | 5.953*** | 5.943*** | 6.108*** |
| 3 | 6.003*** | 6.108*** | 5.990*** | 6.058*** | 6.504*** | 6.217*** |
| 4 | 6.218*** | 6.183*** | 6.033*** | 5.870*** | 5.776*** | 5.648*** |
| 5 | 5.346*** | 5.229*** | 5.233*** | 5.064*** | 4.995*** | 4.533*** |

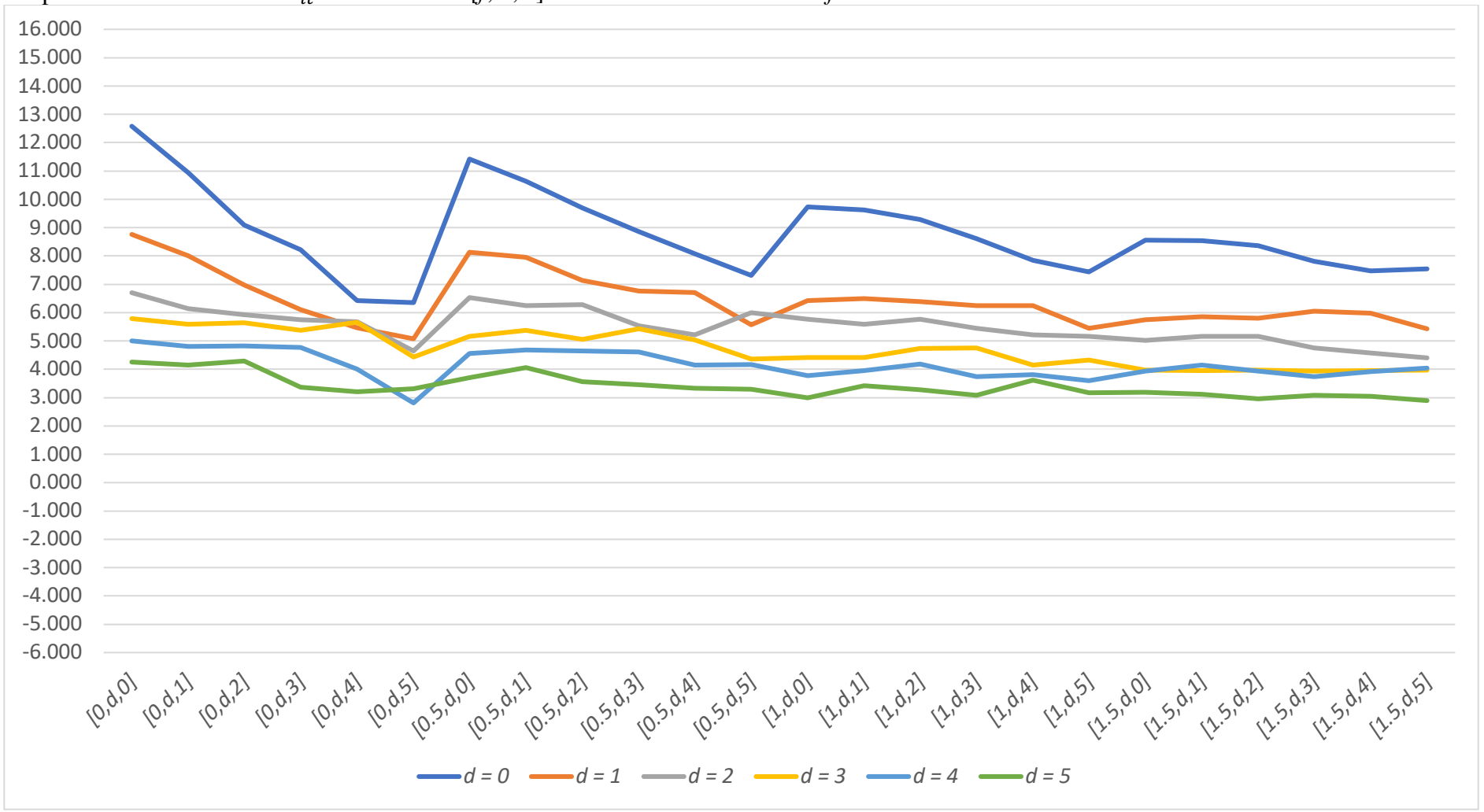
**Appendix 93: EW Japan S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



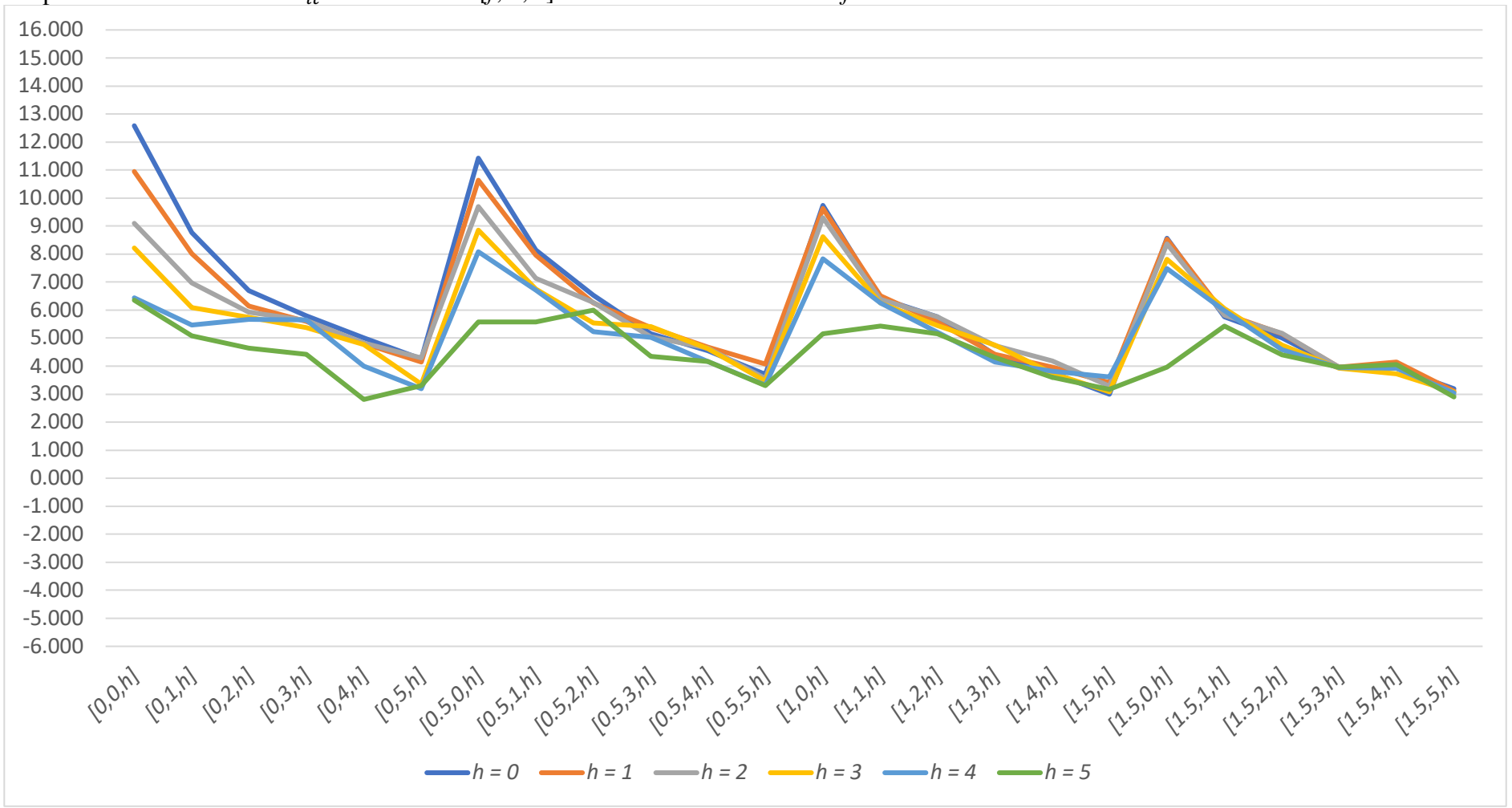
**Appendix 94: EW Japan S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 95: EW Japan S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 96: EW Japan S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.580*** | 10.946*** | 9.092*** | 8.221*** | 6.430*** | 6.353*** |
| 1 | 8.761*** | 8.009*** | 6.973*** | 6.099*** | 5.460*** | 5.076*** |
| 2 | 6.703*** | 6.144*** | 5.934*** | 5.744*** | 5.670*** | 4.642** |
| 3 | 5.788*** | 5.591*** | 5.637*** | 5.380*** | 5.656*** | 4.429** |
| 4 | 5.003** | 4.813** | 4.821** | 4.779** | 3.999** | 2.811 |
| 5 | 4.248** | 4.141** | 4.292** | 3.359 | 3.198 | 3.307* |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.421*** | 10.636*** | 9.696*** | 8.854*** | 8.083*** | 7.311*** |
| 1 | 8.135*** | 7.954*** | 7.130*** | 6.756*** | 6.716*** | 5.580*** |
| 2 | 6.523*** | 6.255*** | 6.275*** | 5.532*** | 5.224*** | 6.006*** |
| 3 | 5.155** | 5.368*** | 5.047** | 5.421*** | 5.030** | 4.357** |
| 4 | 4.558** | 4.685** | 4.639** | 4.615** | 4.157** | 4.161** |
| 5 | 3.705* | 4.068** | 3.563* | 3.464* | 3.329 | 3.304 |

***f = 1***

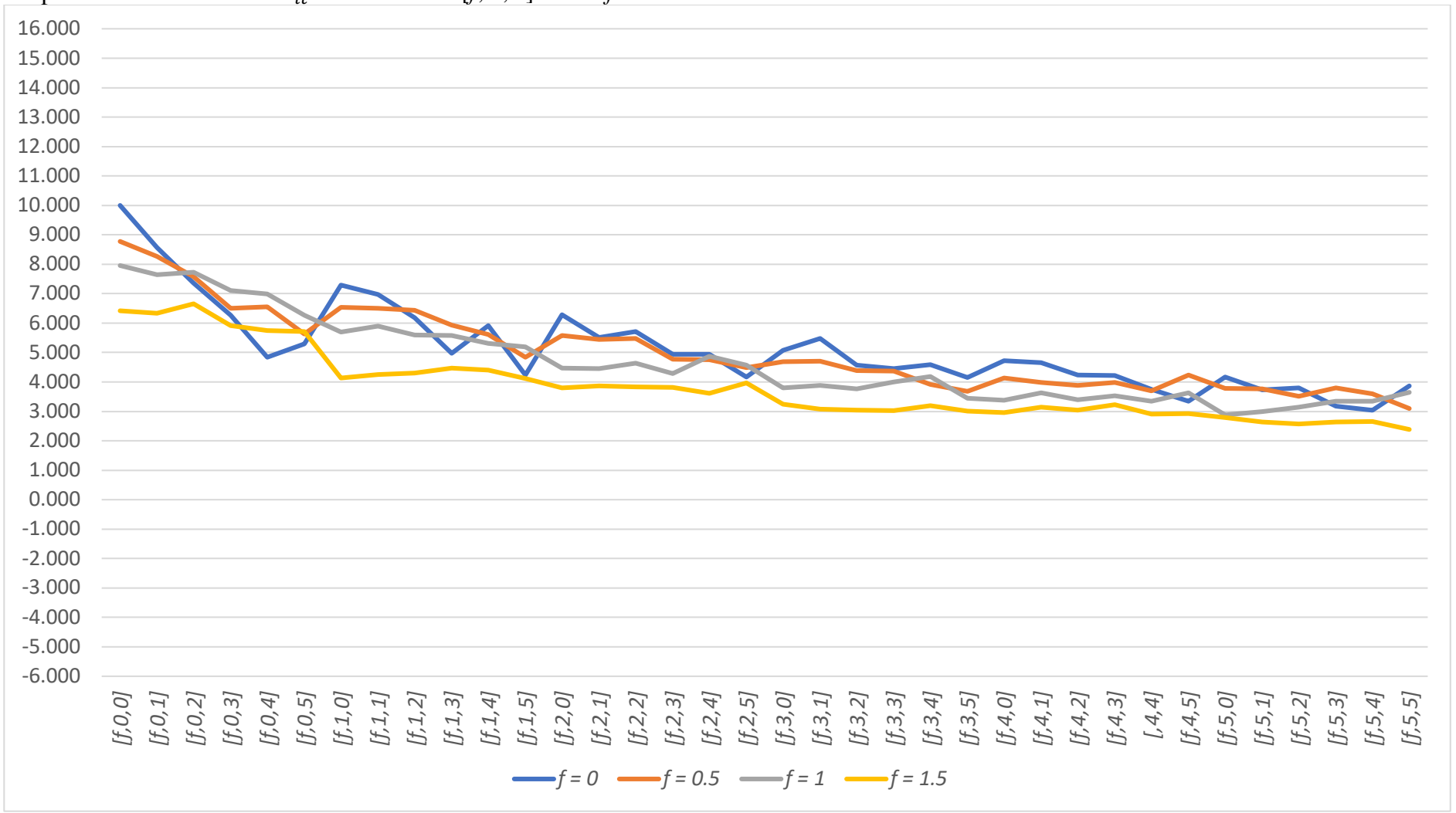
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.739*** | 8.761*** | 8.009*** | 6.973*** | 6.099*** | 5.460*** |
| 1 | 6.425*** | 6.504*** | 6.382*** | 6.252*** | 6.249*** | 5.439*** |
| 2 | 5.765*** | 5.583*** | 5.768*** | 5.446*** | 5.214** | 5.164** |
| 3 | 4.409** | 4.418** | 4.737** | 4.752** | 4.149** | 4.318** |
| 4 | 3.767* | 3.959* | 4.180** | 3.737* | 3.814* | 3.602* |
| 5 | 2.997 | 3.413* | 3.286 | 3.089 | 3.614* | 3.169 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.567*** | 8.135*** | 7.954*** | 7.130*** | 6.756*** | 6.716*** |
| 1 | 5.755*** | 5.862*** | 5.808*** | 6.048*** | 5.979*** | 5.424*** |
| 2 | 5.015** | 5.155** | 5.166** | 4.759** | 4.579** | 4.403** |
| 3 | 3.973* | 3.955* | 3.968* | 3.936* | 3.949* | 3.972* |
| 4 | 3.930* | 4.154** | 3.934* | 3.731* | 3.920* | 4.049** |
| 5 | 3.186 | 3.109 | 2.963 | 3.078 | 3.045 | 2.895 |

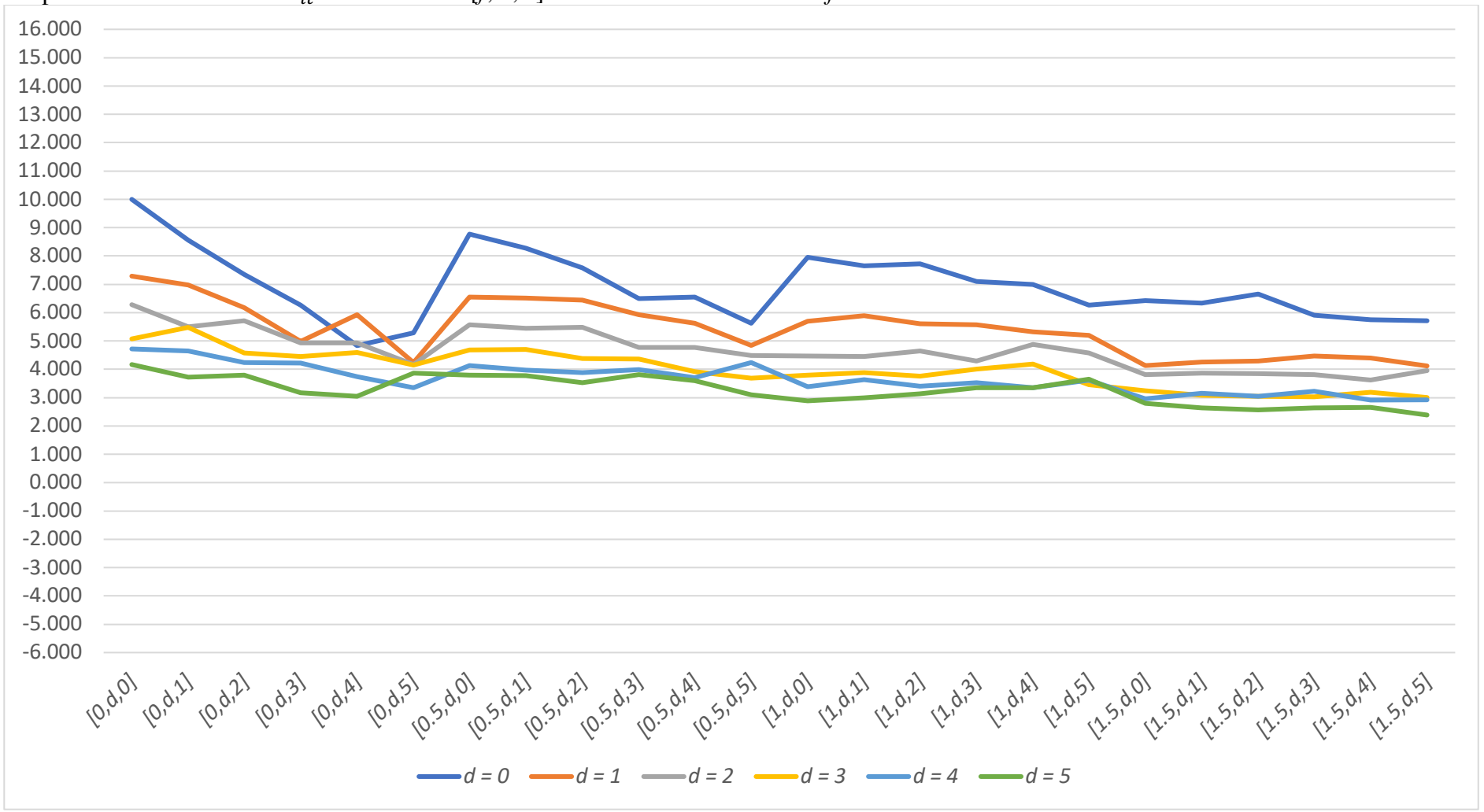
**Appendix 97: EW Japan S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



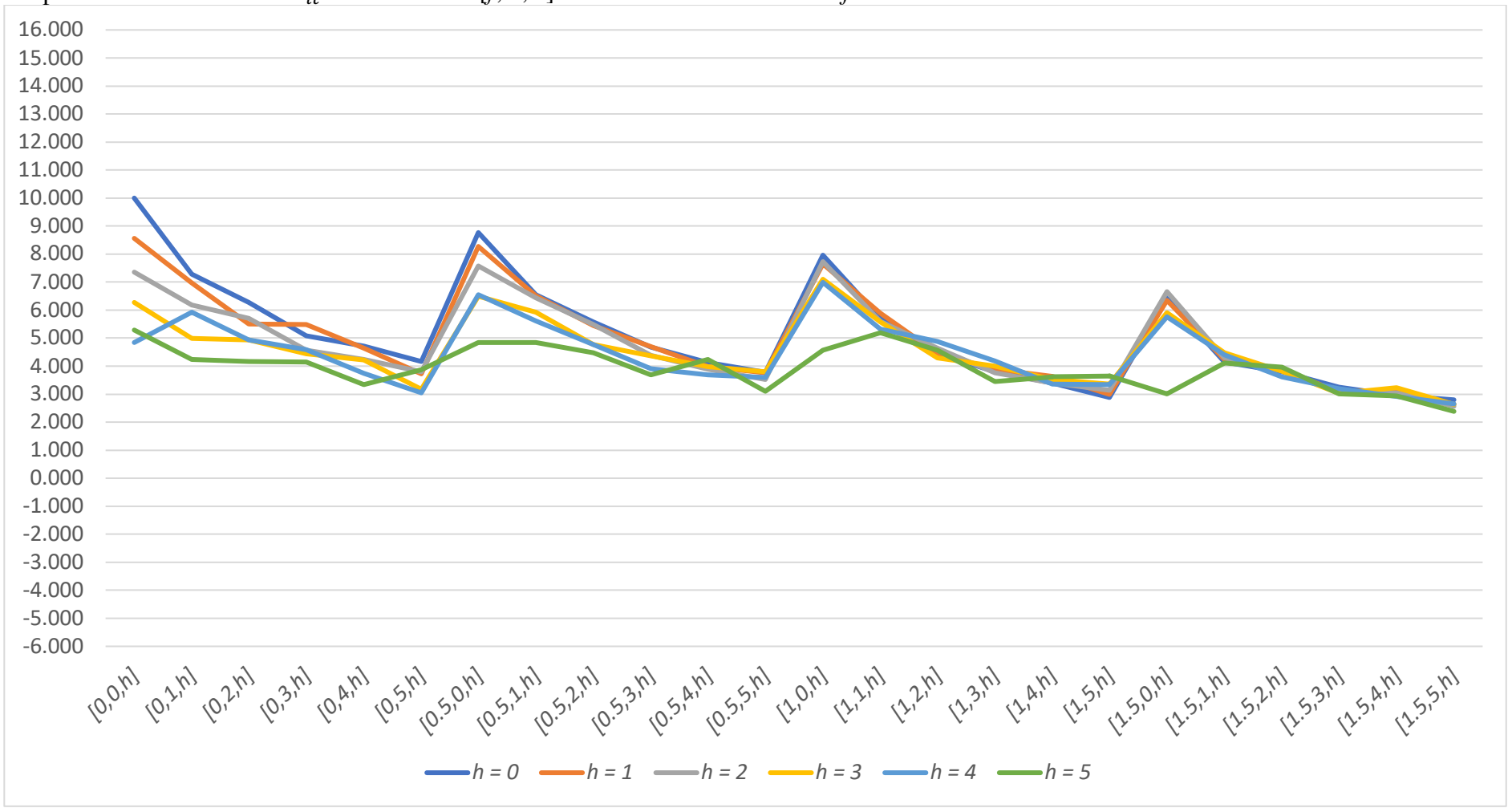
**Appendix 98: EW Japan S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 99: EW Japan S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 100: EW Japan S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.999*** | 8.561*** | 7.351*** | 6.271*** | 4.835*** | 5.288*** |
| 1 | 7.288*** | 6.974*** | 6.182*** | 4.982*** | 5.921*** | 4.233*** |
| 2 | 6.281*** | 5.504*** | 5.707*** | 4.935*** | 4.936*** | 4.168*** |
| 3 | 5.079*** | 5.479*** | 4.569*** | 4.446*** | 4.590*** | 4.153*** |
| 4 | 4.718*** | 4.649*** | 4.238*** | 4.221*** | 3.742** | 3.340** |
| 5 | 4.167** | 3.728** | 3.799** | 3.172* | 3.039* | 3.867** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.775*** | 8.265*** | 7.581*** | 6.502*** | 6.549*** | 5.631*** |
| 1 | 6.543*** | 6.508*** | 6.440*** | 5.933*** | 5.619*** | 4.843*** |
| 2 | 5.578*** | 5.447*** | 5.483*** | 4.774*** | 4.763*** | 4.481*** |
| 3 | 4.683*** | 4.706*** | 4.380*** | 4.364*** | 3.914** | 3.682** |
| 4 | 4.134** | 3.978** | 3.890** | 3.980** | 3.697** | 4.233** |
| 5 | 3.786** | 3.769** | 3.518** | 3.806** | 3.596** | 3.098* |

***f = 1***

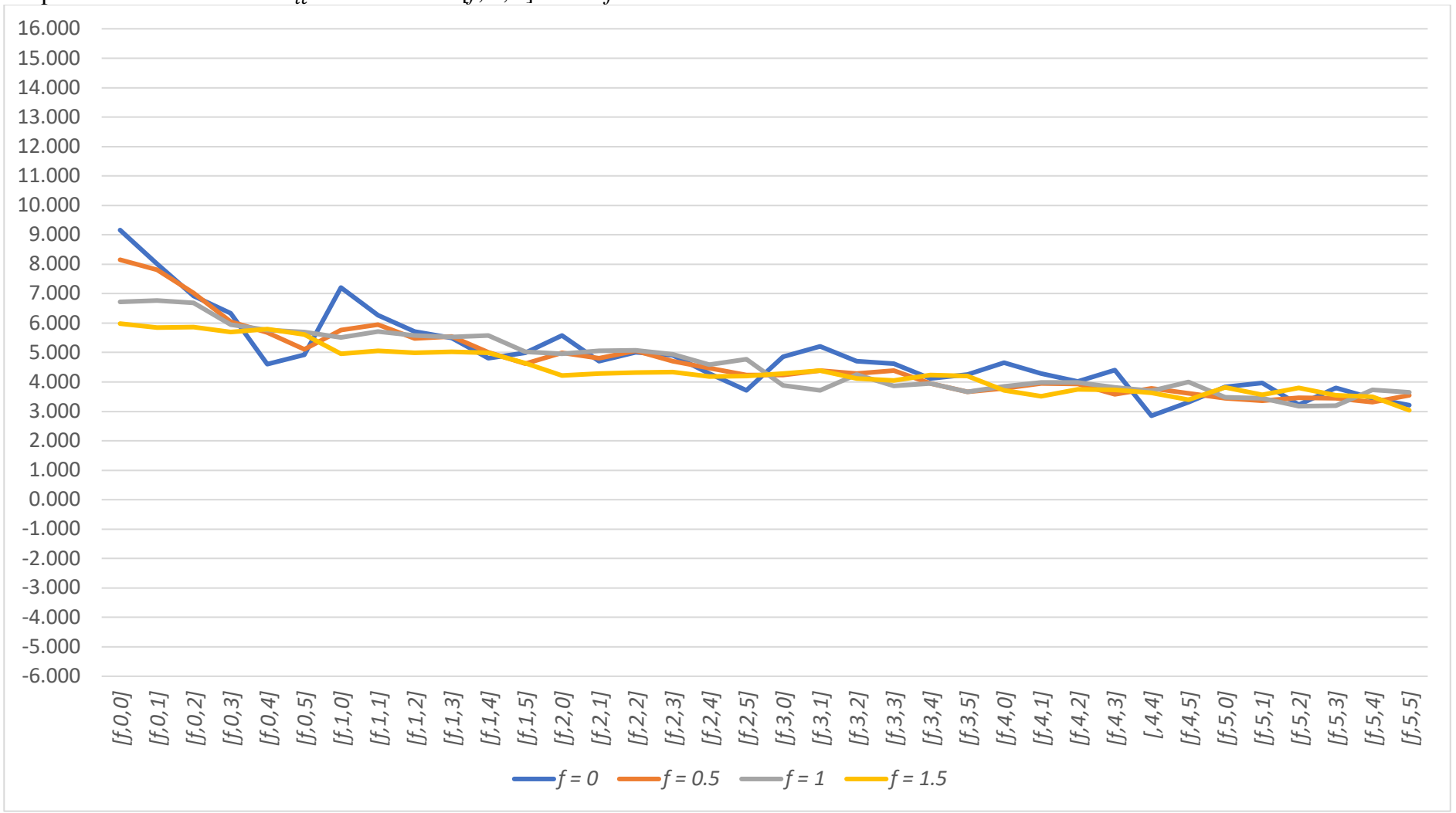
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.956*** | 7.288*** | 6.974*** | 6.182*** | 4.982*** | 5.921*** |
| 1 | 5.703*** | 5.890*** | 5.602*** | 5.572*** | 5.317*** | 5.198*** |
| 2 | 4.467*** | 4.451*** | 4.641*** | 4.294*** | 4.877*** | 4.571*** |
| 3 | 3.798** | 3.882** | 3.764** | 3.998** | 4.187** | 3.450** |
| 4 | 3.387** | 3.633** | 3.402** | 3.522** | 3.351** | 3.623** |
| 5 | 2.880* | 2.990* | 3.137* | 3.353** | 3.344** | 3.646** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.418*** | 6.543*** | 6.508*** | 6.440*** | 5.933*** | 5.619*** |
| 1 | 4.139** | 4.247** | 4.297** | 4.476*** | 4.405*** | 4.118** |
| 2 | 3.804** | 3.864** | 3.838** | 3.811** | 3.621** | 3.960** |
| 3 | 3.241* | 3.083* | 3.045* | 3.021* | 3.188* | 3.004* |
| 4 | 2.951* | 3.147* | 3.047* | 3.225* | 2.914* | 2.930* |
| 5 | 2.798 | 2.640 | 2.567 | 2.637 | 2.653 | 2.386 |

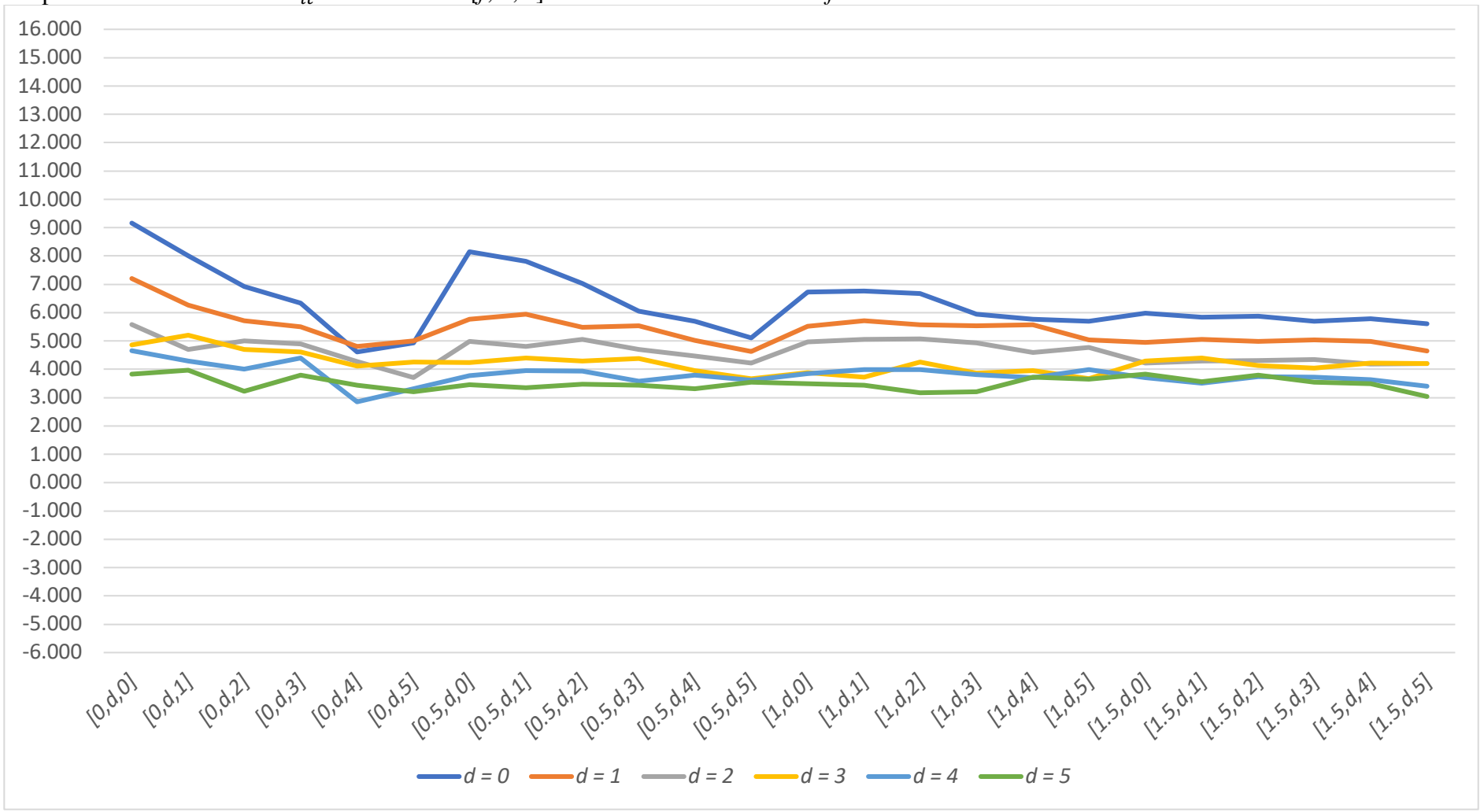
**Appendix 101: EW Japan S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



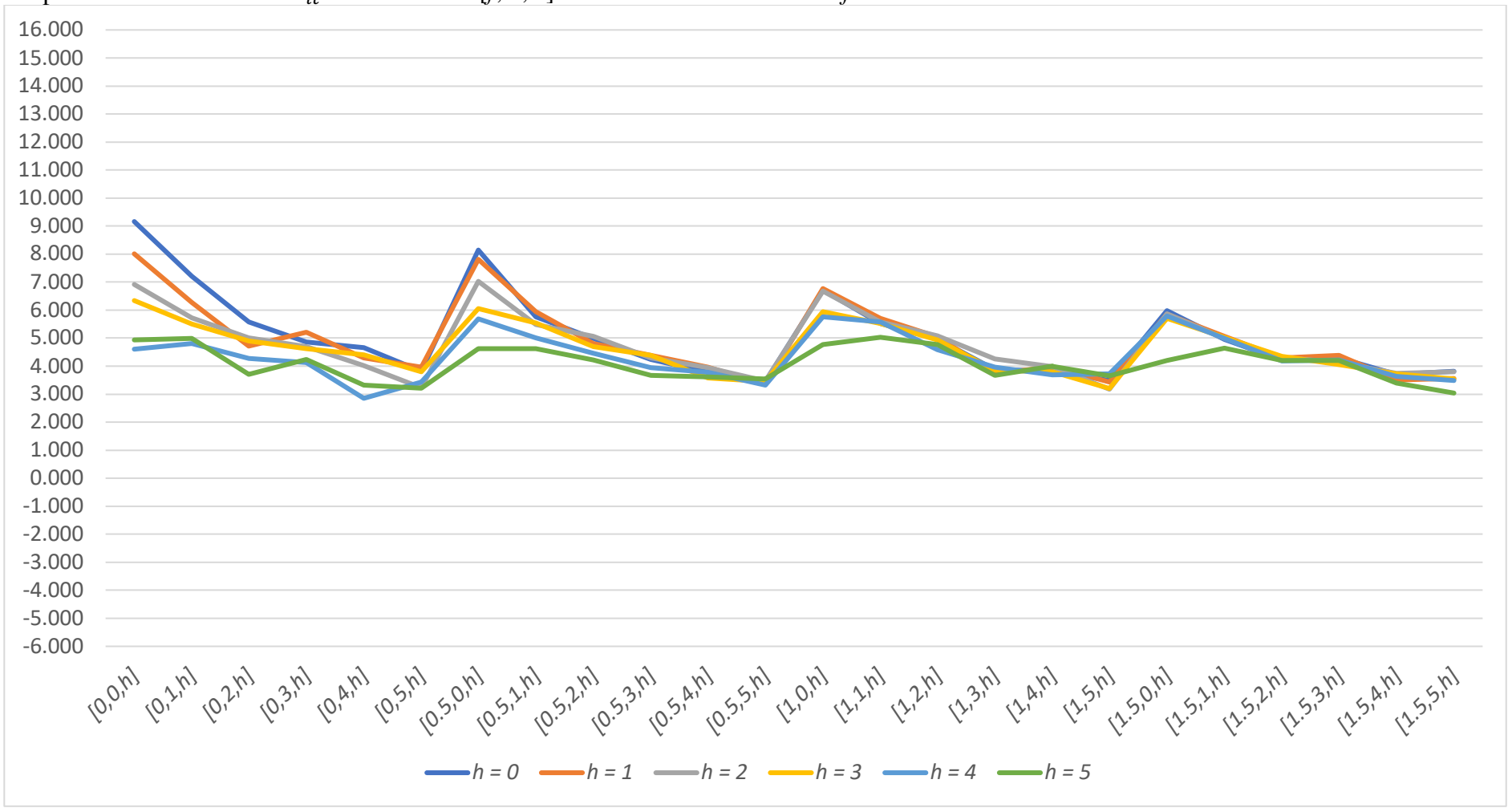
**Appendix 102: EW Japan S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 103: EW Japan S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 104: EW Japan S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.161*** | 8.009*** | 6.915*** | 6.340*** | 4.612*** | 4.928*** |
| 1 | 7.204*** | 6.273*** | 5.716*** | 5.497*** | 4.806*** | 4.995*** |
| 2 | 5.580*** | 4.707*** | 5.004*** | 4.899*** | 4.280*** | 3.708** |
| 3 | 4.859*** | 5.203*** | 4.701*** | 4.616*** | 4.121*** | 4.247*** |
| 4 | 4.656*** | 4.290*** | 4.014** | 4.398*** | 2.851* | 3.314** |
| 5 | 3.824** | 3.968*** | 3.232** | 3.801** | 3.441** | 3.206** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.152*** | 7.814*** | 7.027*** | 6.053*** | 5.687*** | 5.111*** |
| 1 | 5.767*** | 5.944*** | 5.480*** | 5.543*** | 5.012*** | 4.628*** |
| 2 | 4.992*** | 4.799*** | 5.056*** | 4.704*** | 4.466*** | 4.228*** |
| 3 | 4.230*** | 4.390*** | 4.292*** | 4.385*** | 3.949** | 3.665** |
| 4 | 3.783** | 3.958** | 3.940** | 3.586** | 3.788** | 3.613** |
| 5 | 3.452** | 3.354** | 3.468** | 3.443** | 3.314** | 3.548** |

***f = 1***

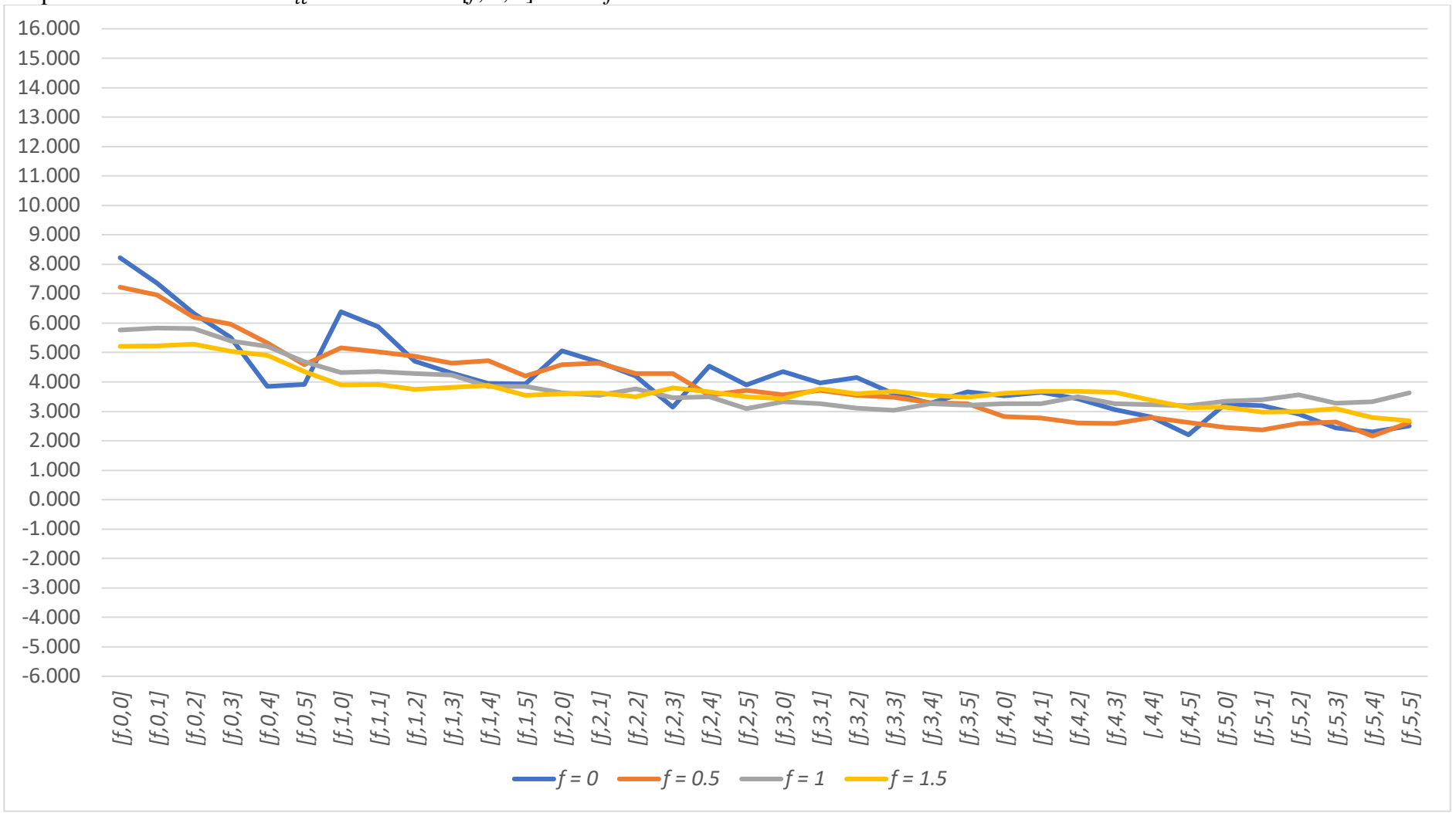
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.722*** | 7.204*** | 6.273*** | 5.716*** | 5.497*** | 4.806*** |
| 1 | 5.514*** | 5.708*** | 5.580*** | 5.531*** | 5.573*** | 5.030*** |
| 2 | 4.964*** | 5.053*** | 5.082*** | 4.936*** | 4.585*** | 4.766*** |
| 3 | 3.878** | 3.722** | 4.249*** | 3.859** | 3.955** | 3.666** |
| 4 | 3.844** | 3.990** | 3.984** | 3.808** | 3.698** | 3.993** |
| 5 | 3.488** | 3.441** | 3.177** | 3.202** | 3.726** | 3.652** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.982*** | 5.767*** | 5.944*** | 5.480*** | 5.543*** | 5.012*** |
| 1 | 4.956*** | 5.062*** | 4.992*** | 5.033*** | 4.983*** | 4.644*** |
| 2 | 4.220*** | 4.291*** | 4.317*** | 4.344*** | 4.185*** | 4.198*** |
| 3 | 4.285*** | 4.389*** | 4.124*** | 4.048** | 4.227*** | 4.207*** |
| 4 | 3.707** | 3.507** | 3.744** | 3.727** | 3.637** | 3.395** |
| 5 | 3.820** | 3.561** | 3.801** | 3.543** | 3.491** | 3.039* |

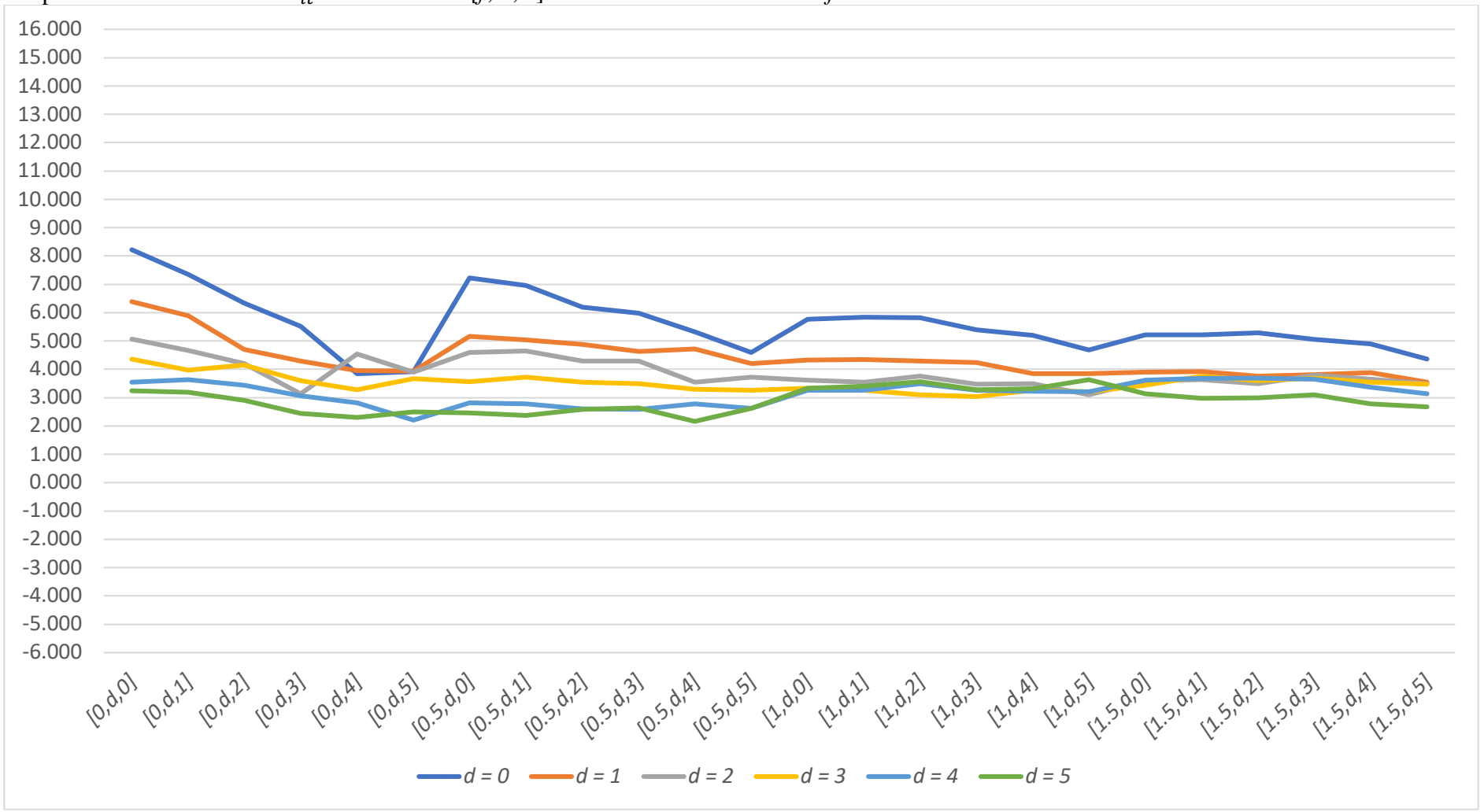
**Appendix 105: EW Japan S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



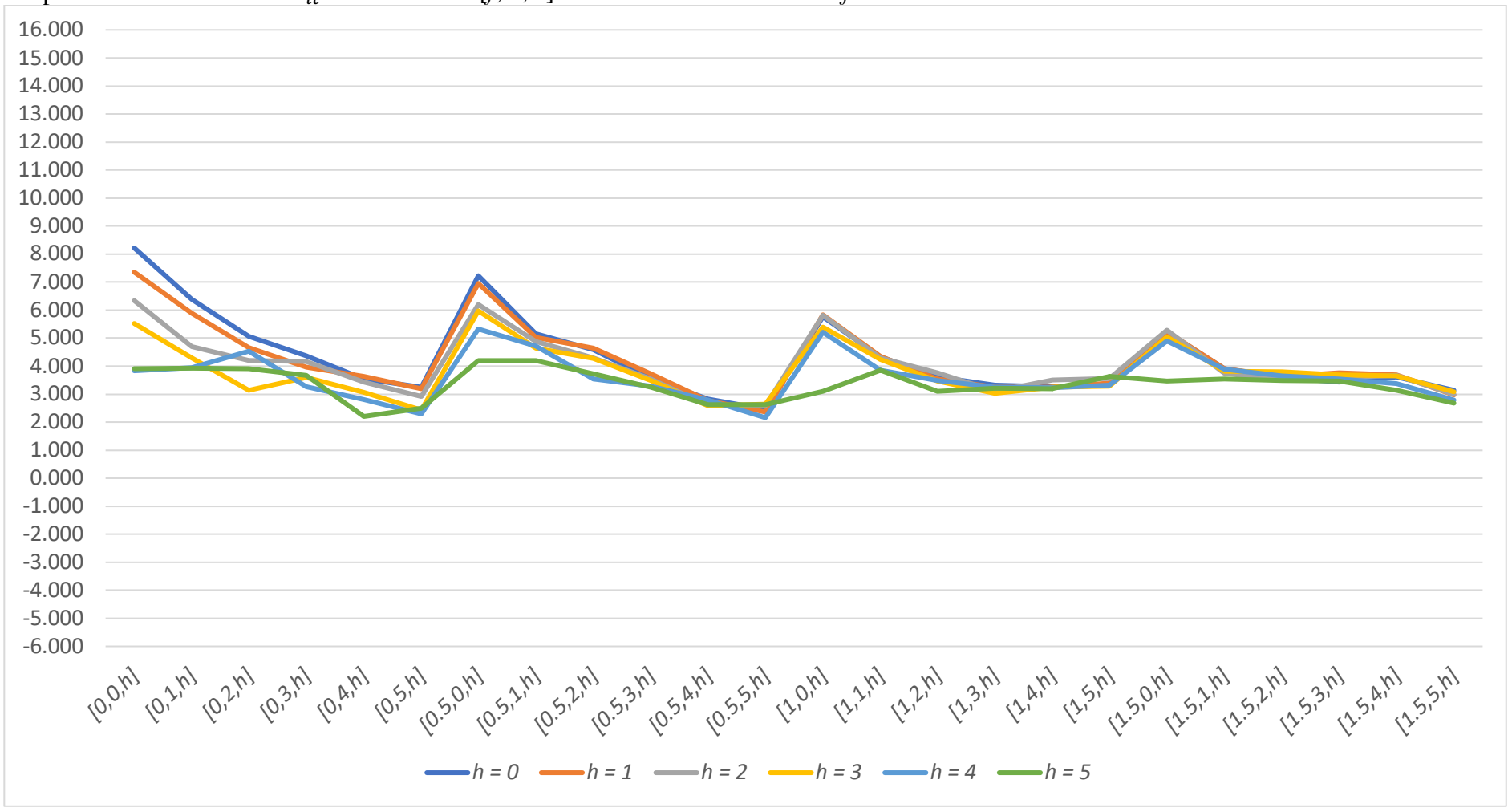
**Appendix 106: EW Japan S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 107: EW Japan S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 108: EW Japan S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.220*** | 7.355*** | 6.339*** | 5.520*** | 3.843*** | 3.909*** |
| 1 | 6.388*** | 5.888*** | 4.703*** | 4.298*** | 3.947*** | 3.930*** |
| 2 | 5.066*** | 4.668*** | 4.210*** | 3.138** | 4.539*** | 3.905*** |
| 3 | 4.358*** | 3.968*** | 4.157*** | 3.592** | 3.275** | 3.668** |
| 4 | 3.536** | 3.641** | 3.434** | 3.068** | 2.815* | 2.205 |
| 5 | 3.240** | 3.192** | 2.912* | 2.435* | 2.302 | 2.499* |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.221*** | 6.961*** | 6.199*** | 5.972*** | 5.326*** | 4.596*** |
| 1 | 5.156*** | 5.029*** | 4.875*** | 4.636*** | 4.714*** | 4.198*** |
| 2 | 4.590*** | 4.644*** | 4.291*** | 4.283*** | 3.539** | 3.717** |
| 3 | 3.569** | 3.717** | 3.542** | 3.484** | 3.291** | 3.258** |
| 4 | 2.821* | 2.778* | 2.601* | 2.583* | 2.785* | 2.618* |
| 5 | 2.461 | 2.363 | 2.591* | 2.644* | 2.161 | 2.628* |

***f = 1***

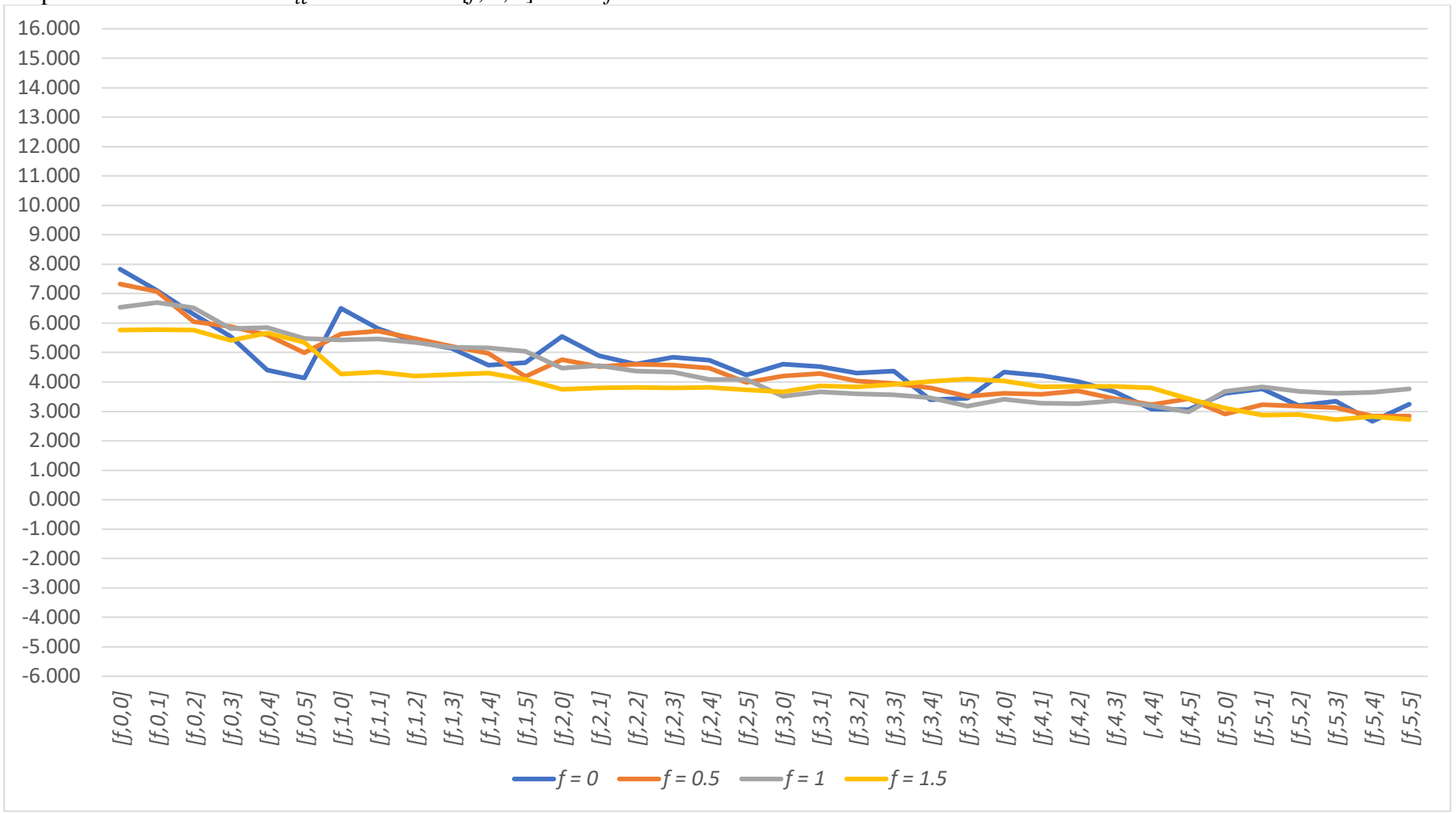
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.769*** | 6.388*** | 5.888*** | 4.703*** | 4.298*** | 3.947*** |
| 1 | 4.325*** | 4.347*** | 4.291*** | 4.243*** | 3.850** | 3.854** |
| 2 | 3.624** | 3.546** | 3.757** | 3.471** | 3.496** | 3.100** |
| 3 | 3.329** | 3.255** | 3.107** | 3.037** | 3.255** | 3.208** |
| 4 | 3.261** | 3.253** | 3.498** | 3.258** | 3.232** | 3.200** |
| 5 | 3.338** | 3.400** | 3.564** | 3.282** | 3.321** | 3.633** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.215*** | 5.156*** | 5.029*** | 4.875*** | 4.636*** | 4.714*** |
| 1 | 3.901** | 3.914** | 3.750** | 3.809** | 3.883** | 3.547** |
| 2 | 3.594** | 3.627** | 3.497** | 3.793** | 3.659** | 3.492** |
| 3 | 3.436** | 3.757** | 3.599** | 3.686** | 3.548** | 3.477** |
| 4 | 3.622** | 3.681** | 3.679** | 3.654** | 3.373** | 3.135** |
| 5 | 3.139** | 2.982* | 2.990* | 3.093** | 2.783* | 2.681* |

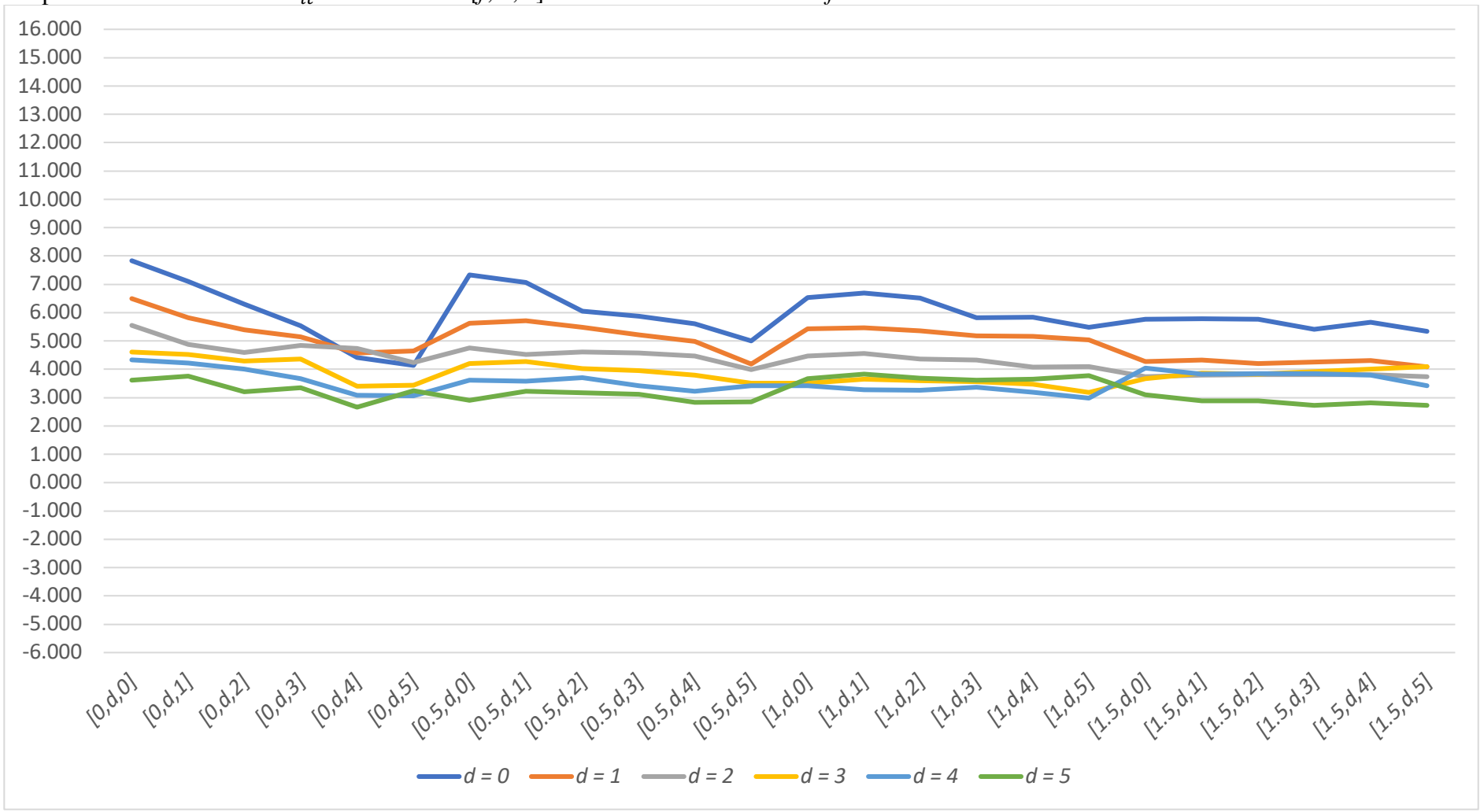
**Appendix 109: EW Japan S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



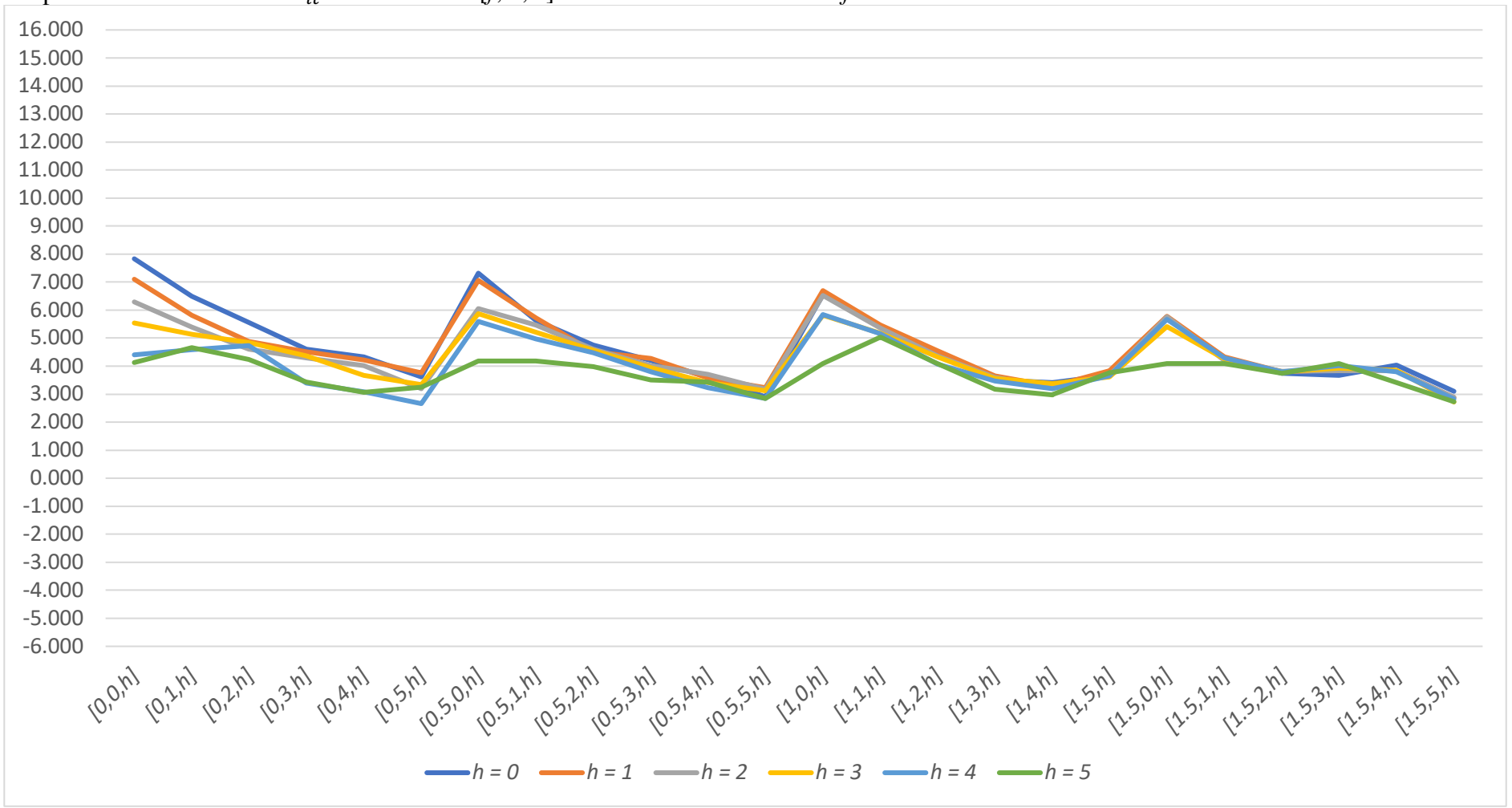
**Appendix 110: EW Japan S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 111: EW Japan S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 112: EW Japan S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.832*** | 7.102*** | 6.297*** | 5.542*** | 4.408*** | 4.136*** |
| 1 | 6.495*** | 5.814*** | 5.385*** | 5.144*** | 4.579*** | 4.653*** |
| 2 | 5.550*** | 4.882*** | 4.599*** | 4.835*** | 4.738*** | 4.233*** |
| 3 | 4.609*** | 4.520*** | 4.298*** | 4.369*** | 3.400** | 3.438** |
| 4 | 4.332*** | 4.223*** | 4.014*** | 3.663*** | 3.080** | 3.061** |
| 5 | 3.622*** | 3.757*** | 3.201** | 3.349** | 2.662* | 3.242** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.326*** | 7.067*** | 6.052*** | 5.873*** | 5.601*** | 4.996*** |
| 1 | 5.631*** | 5.722*** | 5.475*** | 5.208*** | 4.978*** | 4.187*** |
| 2 | 4.759*** | 4.516*** | 4.611*** | 4.573*** | 4.476*** | 3.982*** |
| 3 | 4.198*** | 4.278*** | 4.026*** | 3.946*** | 3.800*** | 3.513** |
| 4 | 3.620** | 3.581** | 3.699*** | 3.423** | 3.232** | 3.428** |
| 5 | 2.904** | 3.222** | 3.171** | 3.119** | 2.841** | 2.846** |

***f = 1***

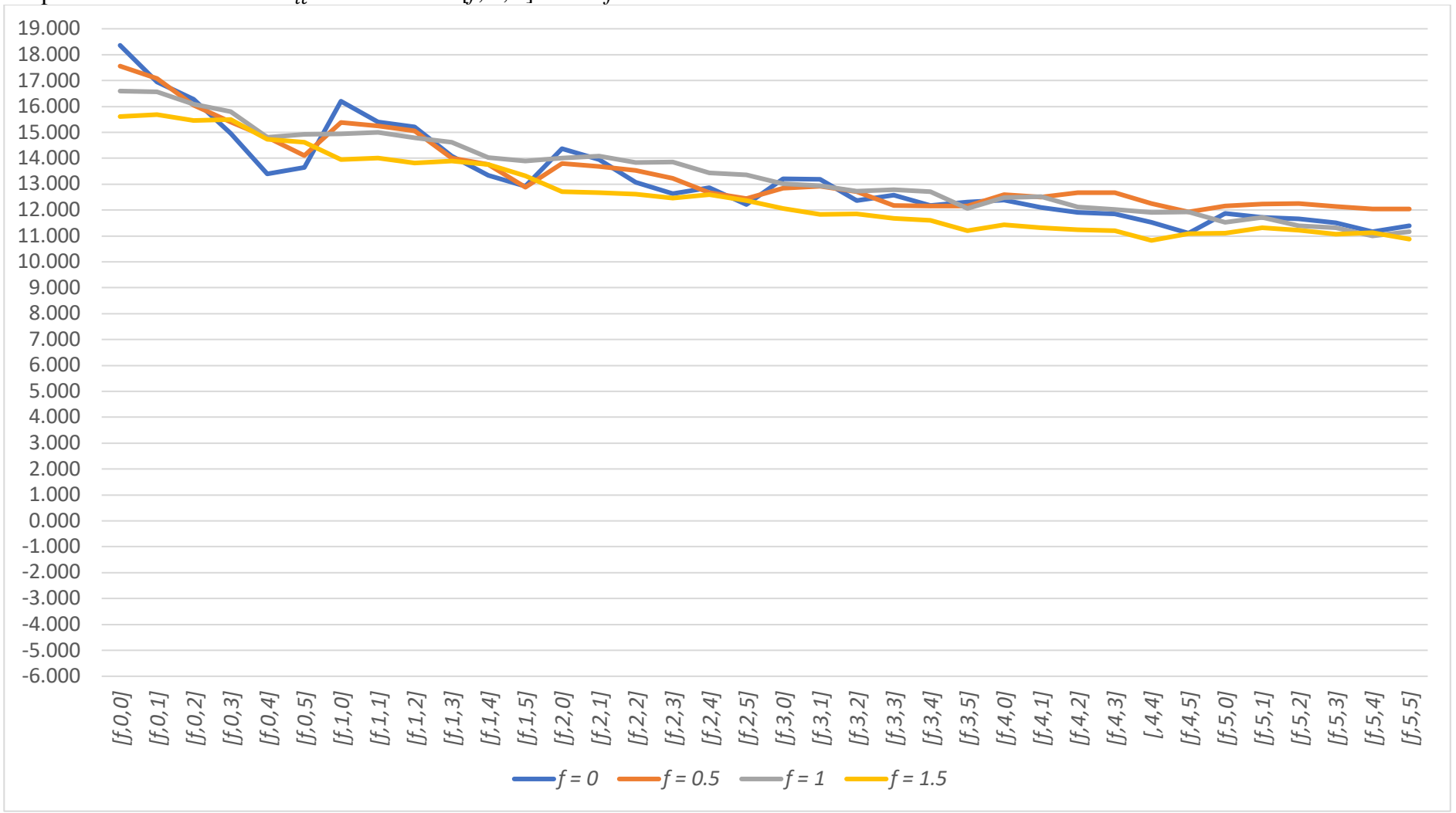
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.540*** | 6.495*** | 5.814*** | 5.385*** | 5.144*** | 4.579*** |
| 1 | 5.432*** | 5.466*** | 5.349*** | 5.176*** | 5.163*** | 5.036*** |
| 2 | 4.472*** | 4.555*** | 4.371*** | 4.333*** | 4.076*** | 4.092*** |
| 3 | 3.514** | 3.659** | 3.598** | 3.564** | 3.470** | 3.183** |
| 4 | 3.417** | 3.278** | 3.268** | 3.369** | 3.187** | 2.982** |
| 5 | 3.675** | 3.830*** | 3.678** | 3.610** | 3.652** | 3.767** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.766*** | 5.631*** | 5.722*** | 5.475*** | 5.208*** | 4.978*** |
| 1 | 4.268*** | 4.334*** | 4.210*** | 4.249*** | 4.301*** | 4.086*** |
| 2 | 3.741*** | 3.793*** | 3.815*** | 3.807*** | 3.808*** | 3.738*** |
| 3 | 3.665** | 3.865*** | 3.830*** | 3.919*** | 4.015*** | 4.094*** |
| 4 | 4.039*** | 3.837*** | 3.844*** | 3.855*** | 3.798*** | 3.421** |
| 5 | 3.108** | 2.881** | 2.889** | 2.720* | 2.822* | 2.730* |

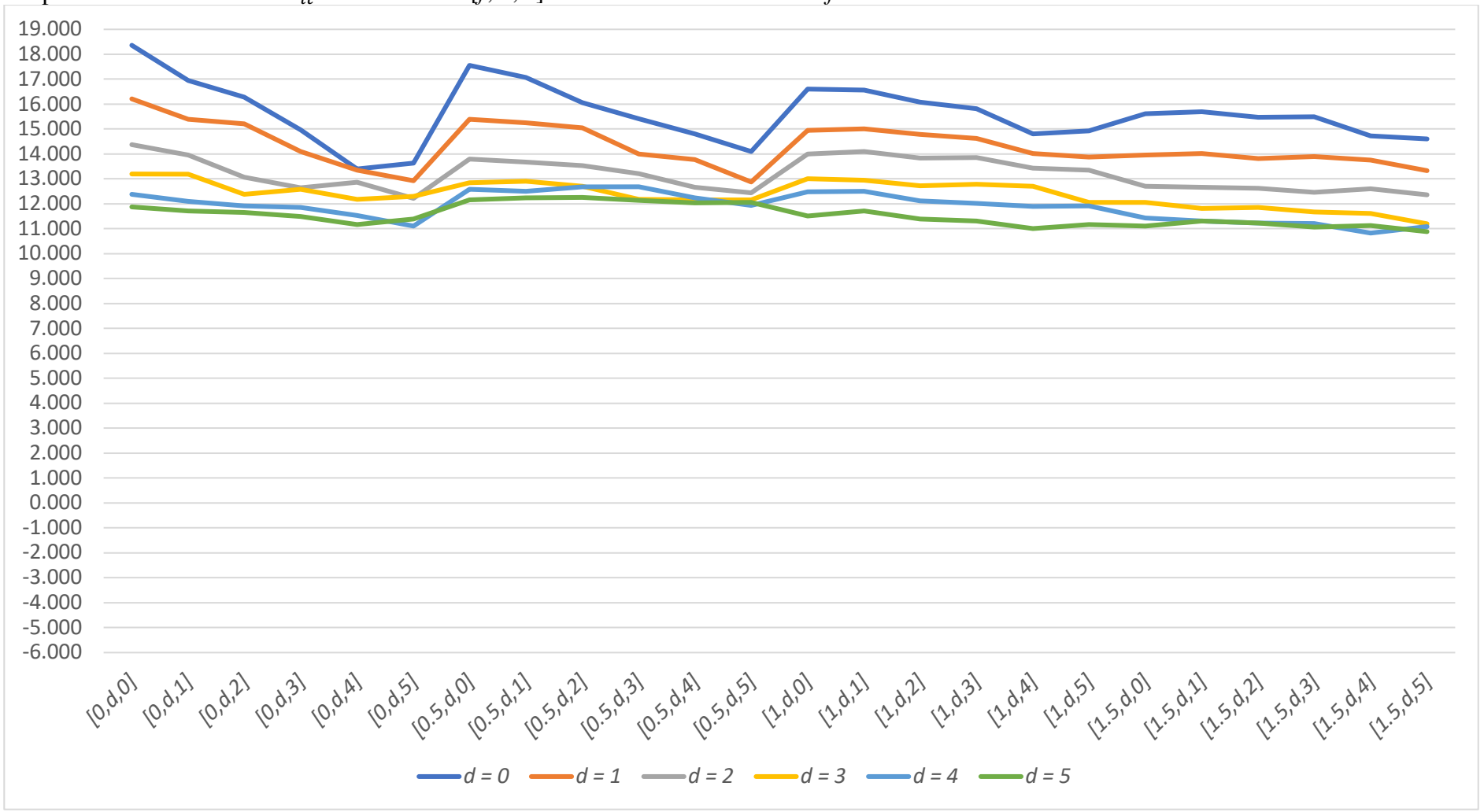
**Appendix 113: VW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



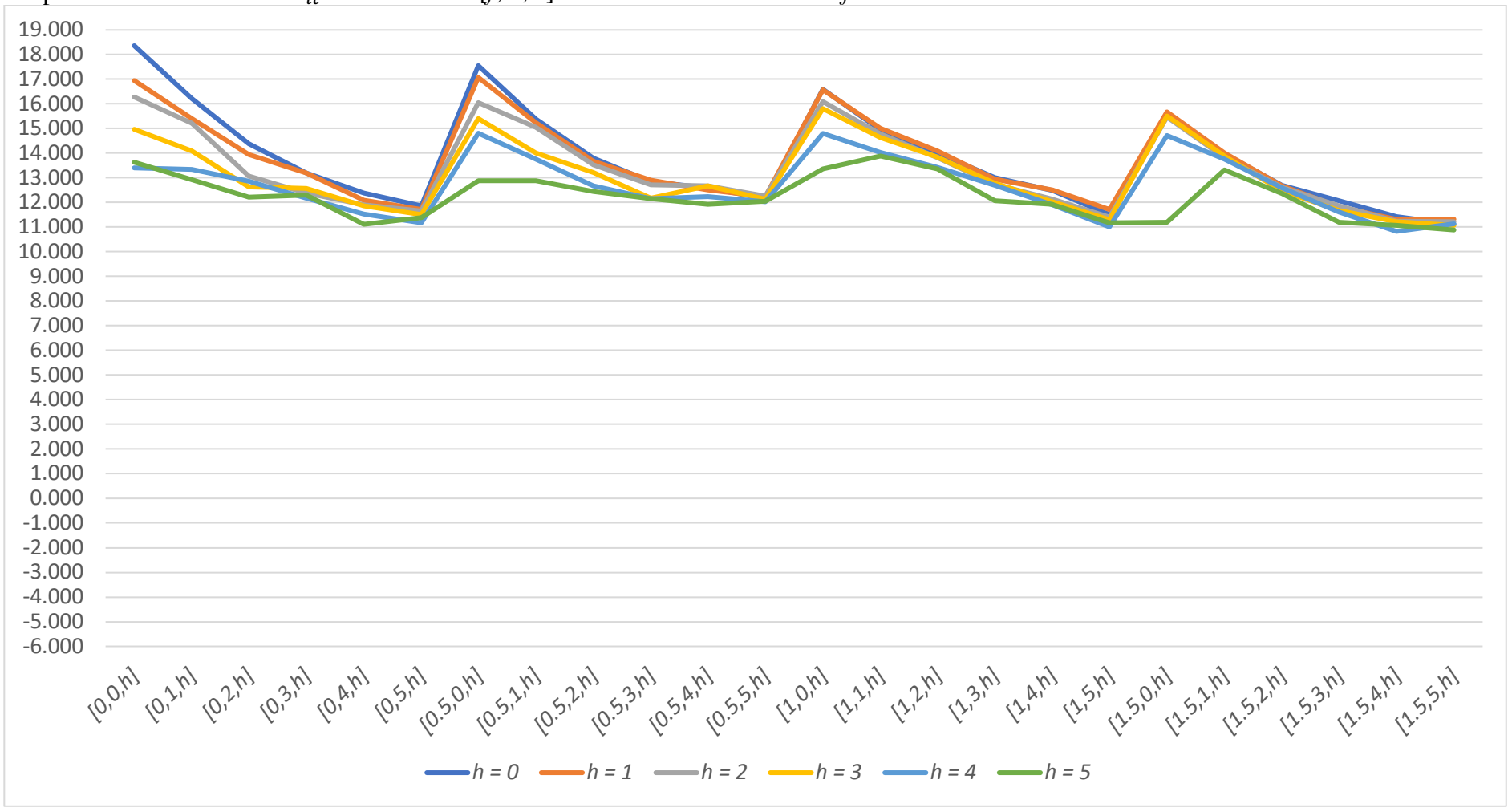
**Appendix 114: VW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 115: VW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 116: VW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 18.361*** | 16.953*** | 16.279*** | 14.966*** | 13.399*** | 13.641*** |
| 1 | 16.211*** | 15.401*** | 15.212*** | 14.093*** | 13.347*** | 12.930*** |
| 2 | 14.375*** | 13.954*** | 13.075*** | 12.635*** | 12.858*** | 12.220*** |
| 3 | 13.198*** | 13.189*** | 12.377*** | 12.582*** | 12.175*** | 12.306*** |
| 4 | 12.387*** | 12.093*** | 11.912*** | 11.861*** | 11.524*** | 11.107*** |
| 5 | 11.870*** | 11.715*** | 11.659*** | 11.502*** | 11.166*** | 11.386*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 17.559*** | 17.072*** | 16.058*** | 15.404*** | 14.810*** | 14.106*** |
| 1 | 15.392*** | 15.243*** | 15.053*** | 14.006*** | 13.768*** | 12.878*** |
| 2 | 13.802*** | 13.685*** | 13.534*** | 13.218*** | 12.671*** | 12.451*** |
| 3 | 12.853*** | 12.913*** | 12.713*** | 12.171*** | 12.154*** | 12.158*** |
| 4 | 12.587*** | 12.510*** | 12.682*** | 12.679*** | 12.247*** | 11.929*** |
| 5 | 12.157*** | 12.240*** | 12.258*** | 12.141*** | 12.038*** | 12.051*** |

***f = 1***

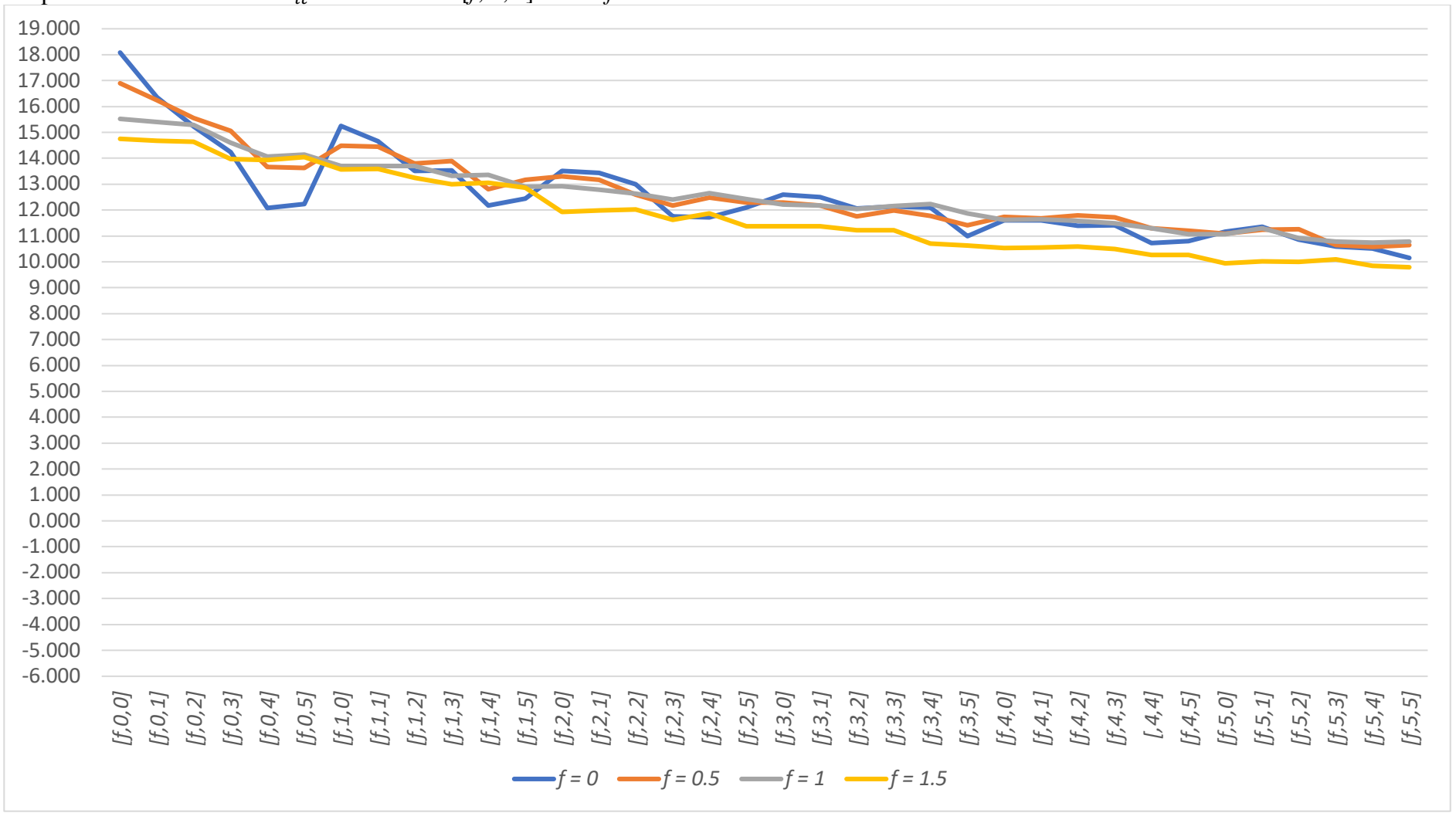
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 16.596*** | 16.211*** | 15.401*** | 15.212*** | 14.093*** | 13.347*** |
| 1 | 14.947*** | 15.000*** | 14.782*** | 14.628*** | 14.023*** | 13.886*** |
| 2 | 14.001*** | 14.090*** | 13.830*** | 13.849*** | 13.434*** | 13.358*** |
| 3 | 13.013*** | 12.939*** | 12.730*** | 12.790*** | 12.703*** | 12.068*** |
| 4 | 12.487*** | 12.513*** | 12.126*** | 12.021*** | 11.906*** | 11.920*** |
| 5 | 11.519*** | 11.715*** | 11.401*** | 11.311*** | 11.003*** | 11.171*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 15.610*** | 15.392*** | 15.243*** | 15.053*** | 14.006*** | 13.768*** |
| 1 | 13.958*** | 14.013*** | 13.813*** | 13.889*** | 13.759*** | 13.327*** |
| 2 | 12.705*** | 12.672*** | 12.624*** | 12.460*** | 12.598*** | 12.366*** |
| 3 | 12.063*** | 11.824*** | 11.861*** | 11.671*** | 11.607*** | 11.201*** |
| 4 | 11.427*** | 11.313*** | 11.233*** | 11.209*** | 10.828*** | 11.080*** |
| 5 | 11.115*** | 11.320*** | 11.222*** | 11.073*** | 11.134*** | 10.885*** |

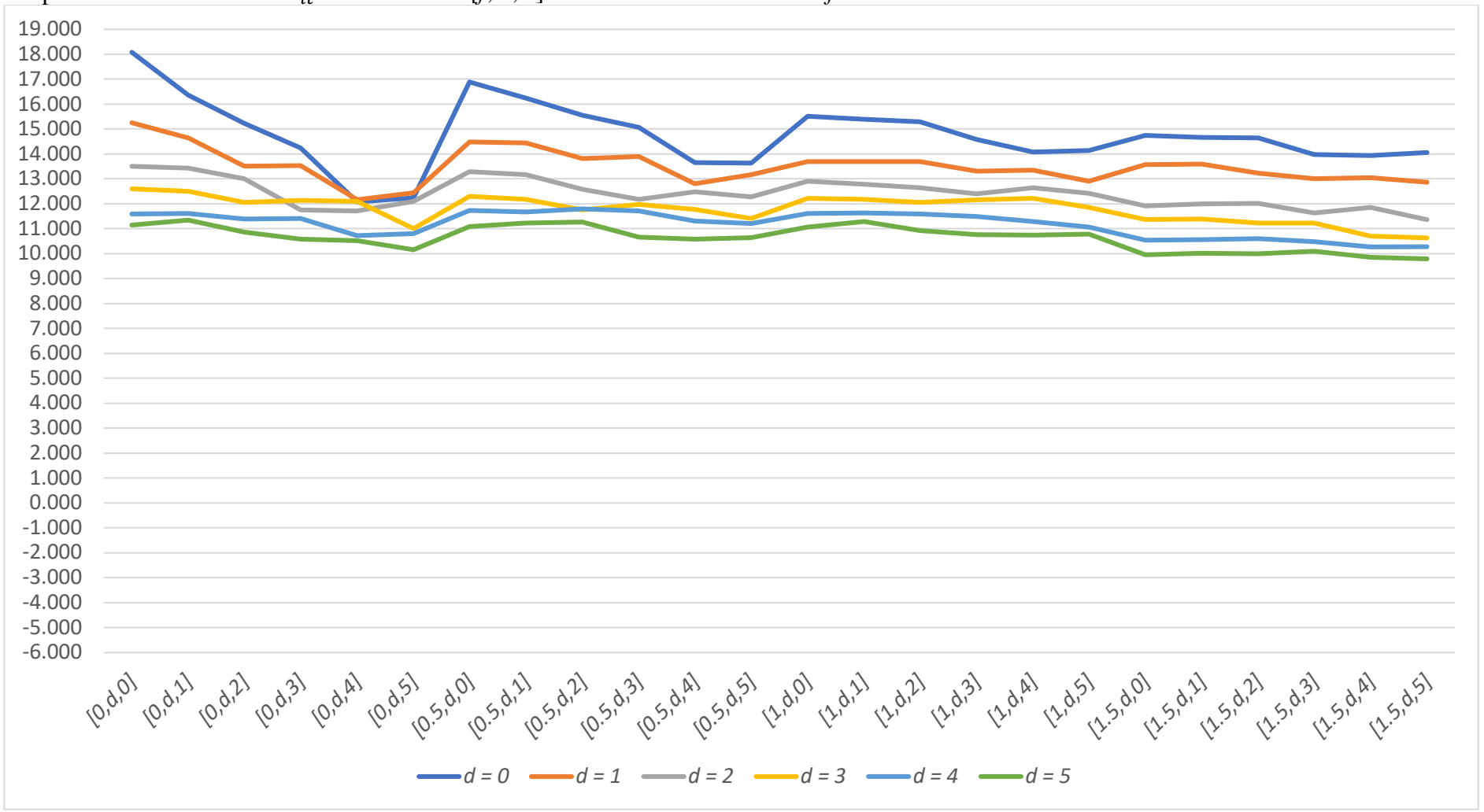
**Appendix 117: VW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



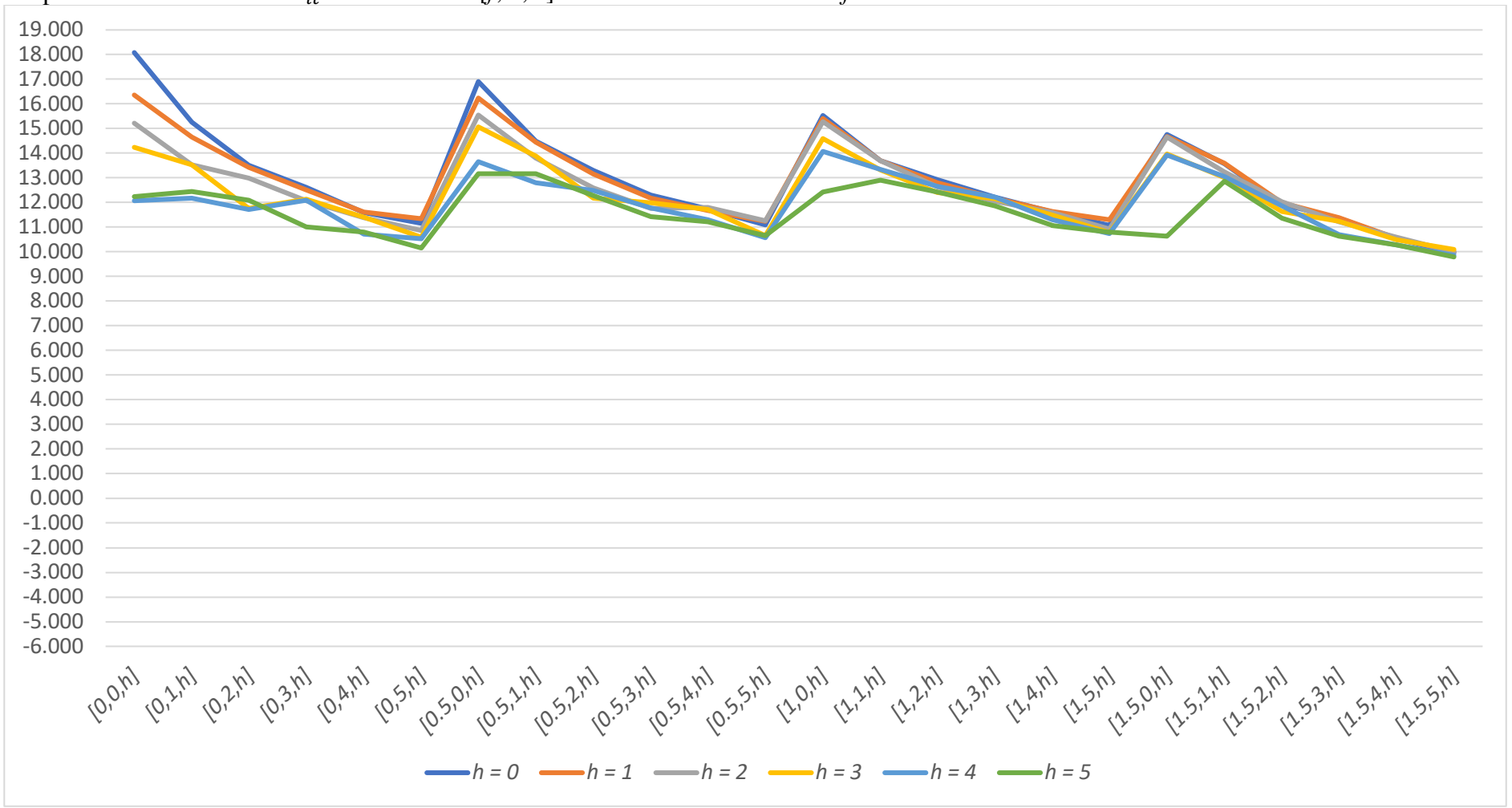
**Appendix 118: VW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 119: VW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 120: VW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 18.082*** | 16.360*** | 15.228*** | 14.245*** | 12.079*** | 12.233*** |
| 1 | 15.253*** | 14.648*** | 13.522*** | 13.528*** | 12.168*** | 12.451*** |
| 2 | 13.506*** | 13.431*** | 12.999*** | 11.765*** | 11.724*** | 12.096*** |
| 3 | 12.604*** | 12.508*** | 12.067*** | 12.132*** | 12.100*** | 11.001*** |
| 4 | 11.599*** | 11.612*** | 11.394*** | 11.413*** | 10.724*** | 10.797*** |
| 5 | 11.157*** | 11.348*** | 10.866*** | 10.584*** | 10.524*** | 10.153*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 16.896*** | 16.234*** | 15.548*** | 15.067*** | 13.659*** | 13.631*** |
| 1 | 14.489*** | 14.444*** | 13.807*** | 13.893*** | 12.802*** | 13.167*** |
| 2 | 13.298*** | 13.161*** | 12.591*** | 12.172*** | 12.482*** | 12.285*** |
| 3 | 12.292*** | 12.181*** | 11.763*** | 11.981*** | 11.785*** | 11.419*** |
| 4 | 11.734*** | 11.683*** | 11.798*** | 11.715*** | 11.302*** | 11.212*** |
| 5 | 11.091*** | 11.238*** | 11.261*** | 10.656*** | 10.579*** | 10.647*** |

***f = 1***

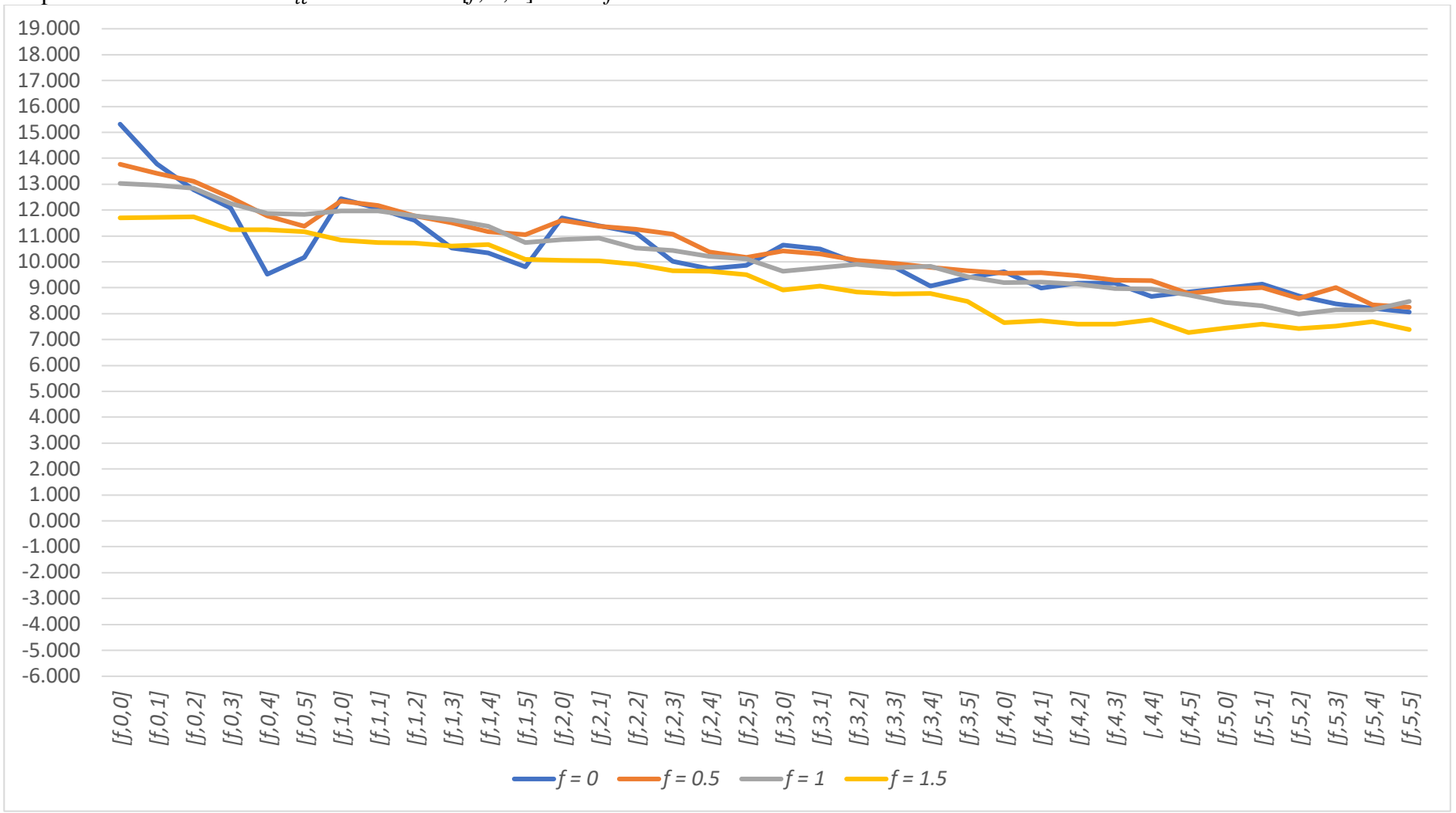
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 15.522*** | 15.253*** | 14.648*** | 13.522*** | 13.528*** | 12.168*** |
| 1 | 13.697*** | 13.703*** | 13.701*** | 13.320*** | 13.352*** | 12.907*** |
| 2 | 12.917*** | 12.794*** | 12.637*** | 12.398*** | 12.647*** | 12.419*** |
| 3 | 12.215*** | 12.174*** | 12.052*** | 12.159*** | 12.227*** | 11.863*** |
| 4 | 11.624*** | 11.642*** | 11.589*** | 11.484*** | 11.301*** | 11.065*** |
| 5 | 11.062*** | 11.293*** | 10.923*** | 10.775*** | 10.744*** | 10.793*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.751*** | 14.489*** | 14.444*** | 13.807*** | 13.893*** | 12.802*** |
| 1 | 13.565*** | 13.592*** | 13.238*** | 13.003*** | 13.053*** | 12.870*** |
| 2 | 11.924*** | 11.992*** | 12.021*** | 11.630*** | 11.863*** | 11.366*** |
| 3 | 11.367*** | 11.382*** | 11.225*** | 11.230*** | 10.706*** | 10.634*** |
| 4 | 10.539*** | 10.557*** | 10.594*** | 10.491*** | 10.272*** | 10.275*** |
| 5 | 9.953*** | 10.013*** | 10.000*** | 10.097*** | 9.855*** | 9.793*** |

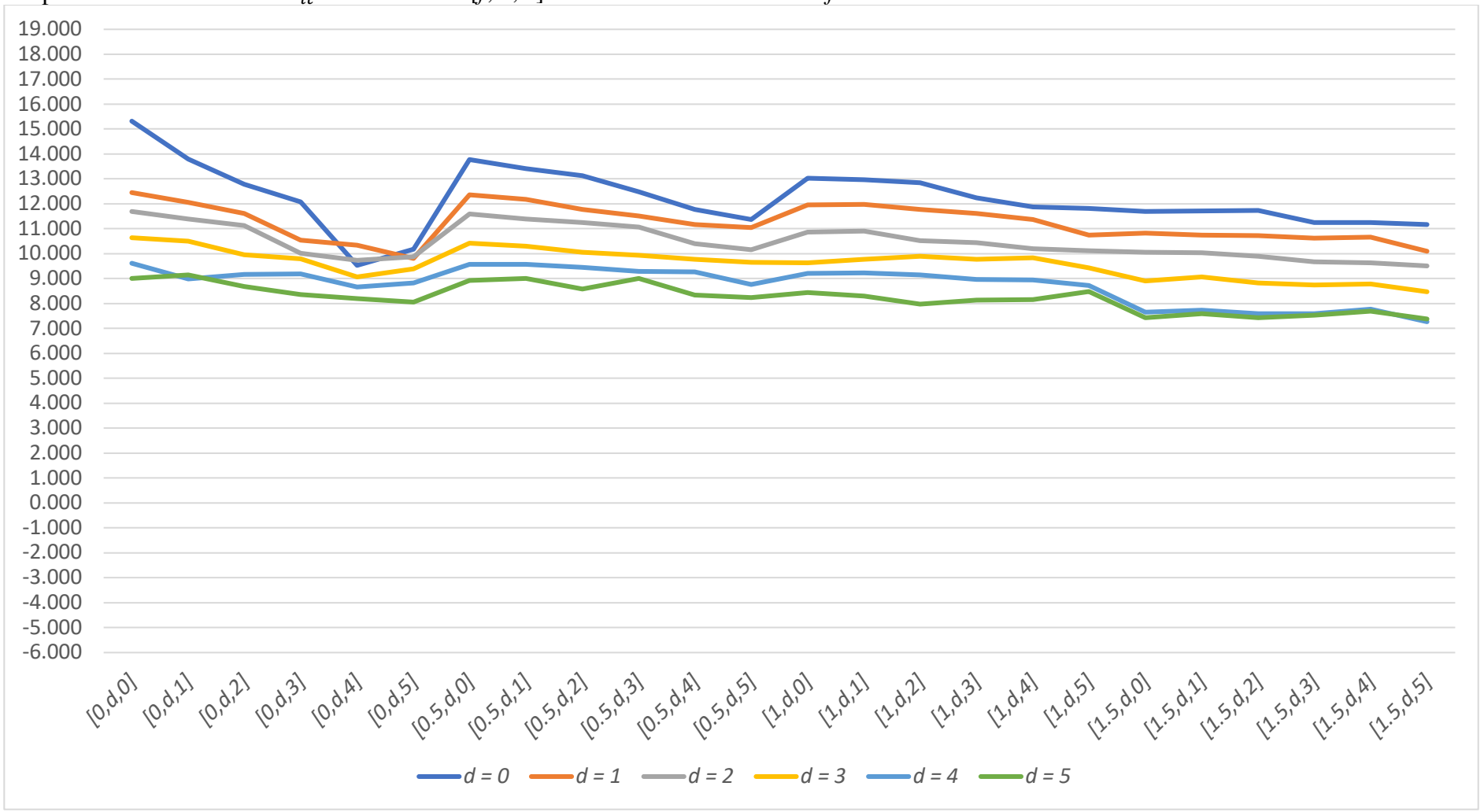
**Appendix 121: VW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



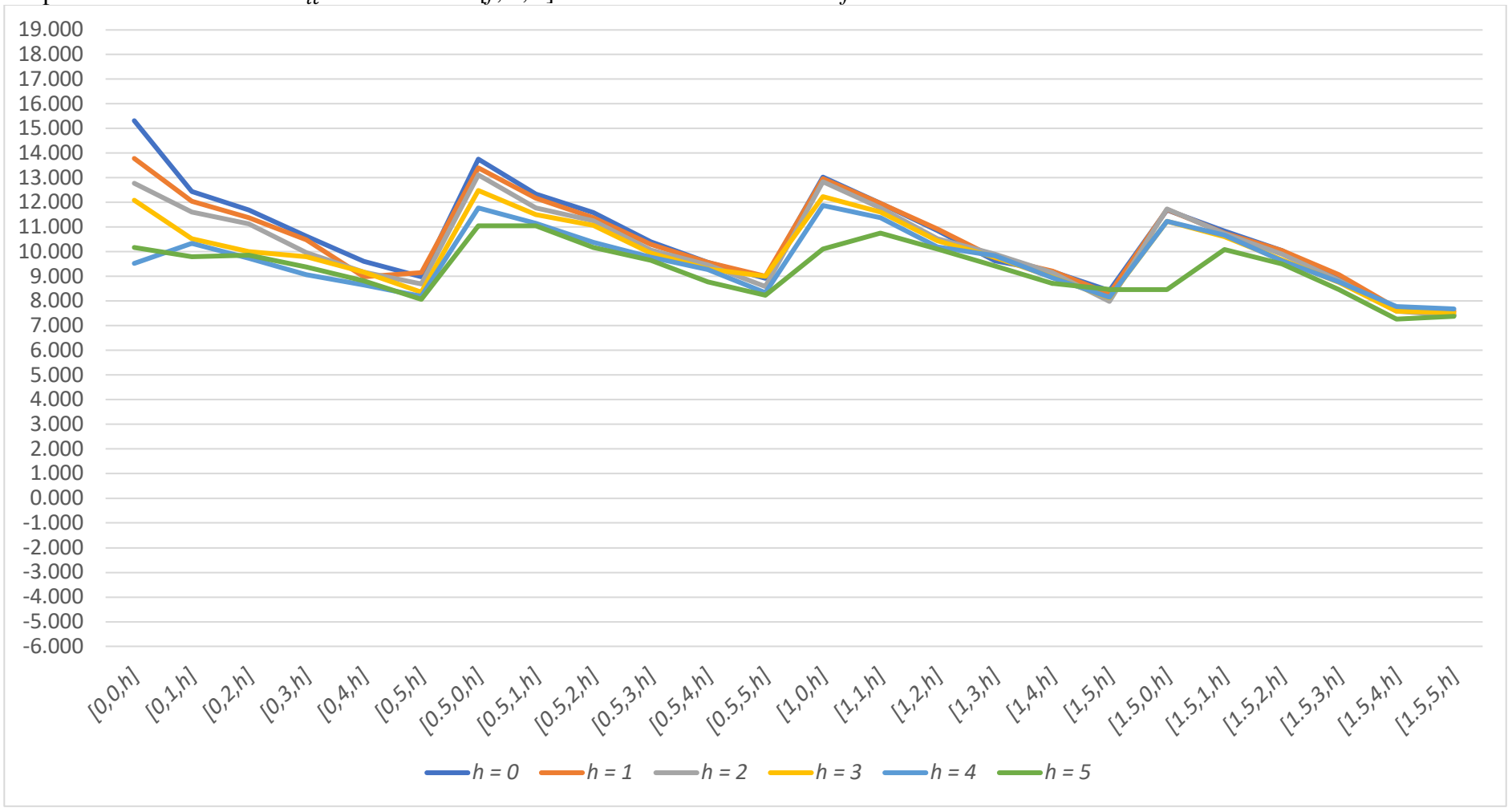
**Appendix 122: VW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 123: VW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 124: VW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 15.318*** | 13.787*** | 12.787*** | 12.087*** | 9.532*** | 10.170*** |
| 1 | 12.452*** | 12.059*** | 11.607*** | 10.540*** | 10.351*** | 9.810*** |
| 2 | 11.694*** | 11.392*** | 11.135*** | 10.013*** | 9.733*** | 9.871*** |
| 3 | 10.641*** | 10.499*** | 9.958*** | 9.801*** | 9.075*** | 9.382*** |
| 4 | 9.617*** | 8.991*** | 9.175*** | 9.185*** | 8.658*** | 8.829*** |
| 5 | 8.999*** | 9.149*** | 8.689*** | 8.370*** | 8.202*** | 8.062*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.769*** | 13.409*** | 13.120*** | 12.488*** | 11.774*** | 11.377*** |
| 1 | 12.352*** | 12.185*** | 11.781*** | 11.515*** | 11.161*** | 11.055*** |
| 2 | 11.596*** | 11.382*** | 11.254*** | 11.075*** | 10.392*** | 10.168*** |
| 3 | 10.415*** | 10.297*** | 10.065*** | 9.938*** | 9.783*** | 9.651*** |
| 4 | 9.566*** | 9.573*** | 9.459*** | 9.295*** | 9.280*** | 8.773*** |
| 5 | 8.931*** | 9.015*** | 8.588*** | 9.016*** | 8.336*** | 8.248*** |

***f = 1***

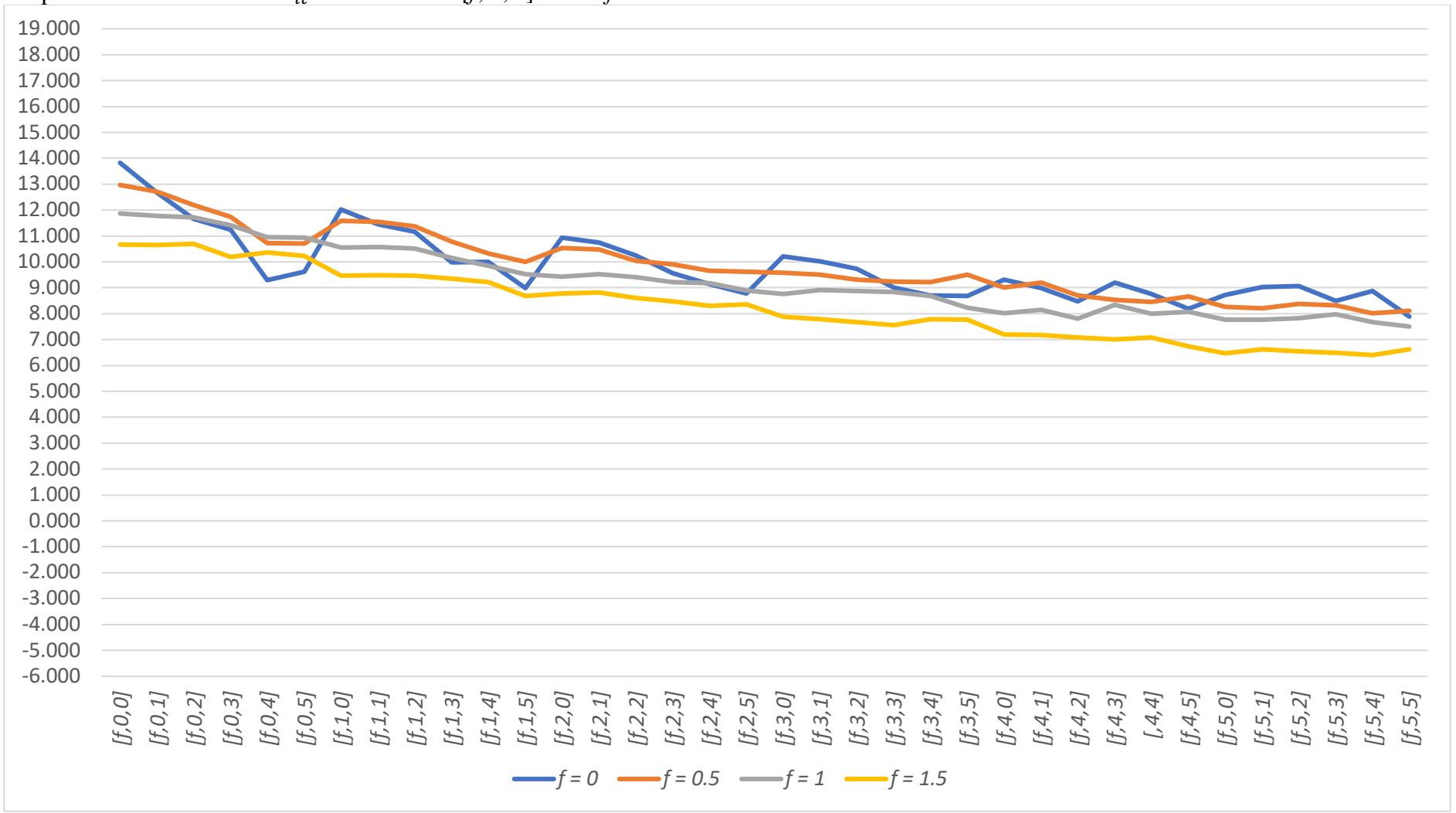
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.029*** | 12.452*** | 12.059*** | 11.607*** | 10.540*** | 10.351*** |
| 1 | 11.963*** | 11.971*** | 11.781*** | 11.617*** | 11.379*** | 10.753*** |
| 2 | 10.860*** | 10.916*** | 10.530*** | 10.438*** | 10.206*** | 10.115*** |
| 3 | 9.634*** | 9.767*** | 9.897*** | 9.781*** | 9.835*** | 9.431*** |
| 4 | 9.206*** | 9.223*** | 9.147*** | 8.968*** | 8.943*** | 8.721*** |
| 5 | 8.434*** | 8.296*** | 7.984*** | 8.144*** | 8.159*** | 8.474*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.700*** | 12.352*** | 12.185*** | 11.781*** | 11.515*** | 11.161*** |
| 1 | 10.836*** | 10.754*** | 10.730*** | 10.616*** | 10.666*** | 10.094*** |
| 2 | 10.053*** | 10.047*** | 9.904*** | 9.667*** | 9.632*** | 9.510*** |
| 3 | 8.916*** | 9.067*** | 8.834*** | 8.754*** | 8.781*** | 8.474*** |
| 4 | 7.649*** | 7.726*** | 7.602*** | 7.597*** | 7.777*** | 7.271*** |
| 5 | 7.438*** | 7.593*** | 7.424*** | 7.528*** | 7.685*** | 7.382*** |

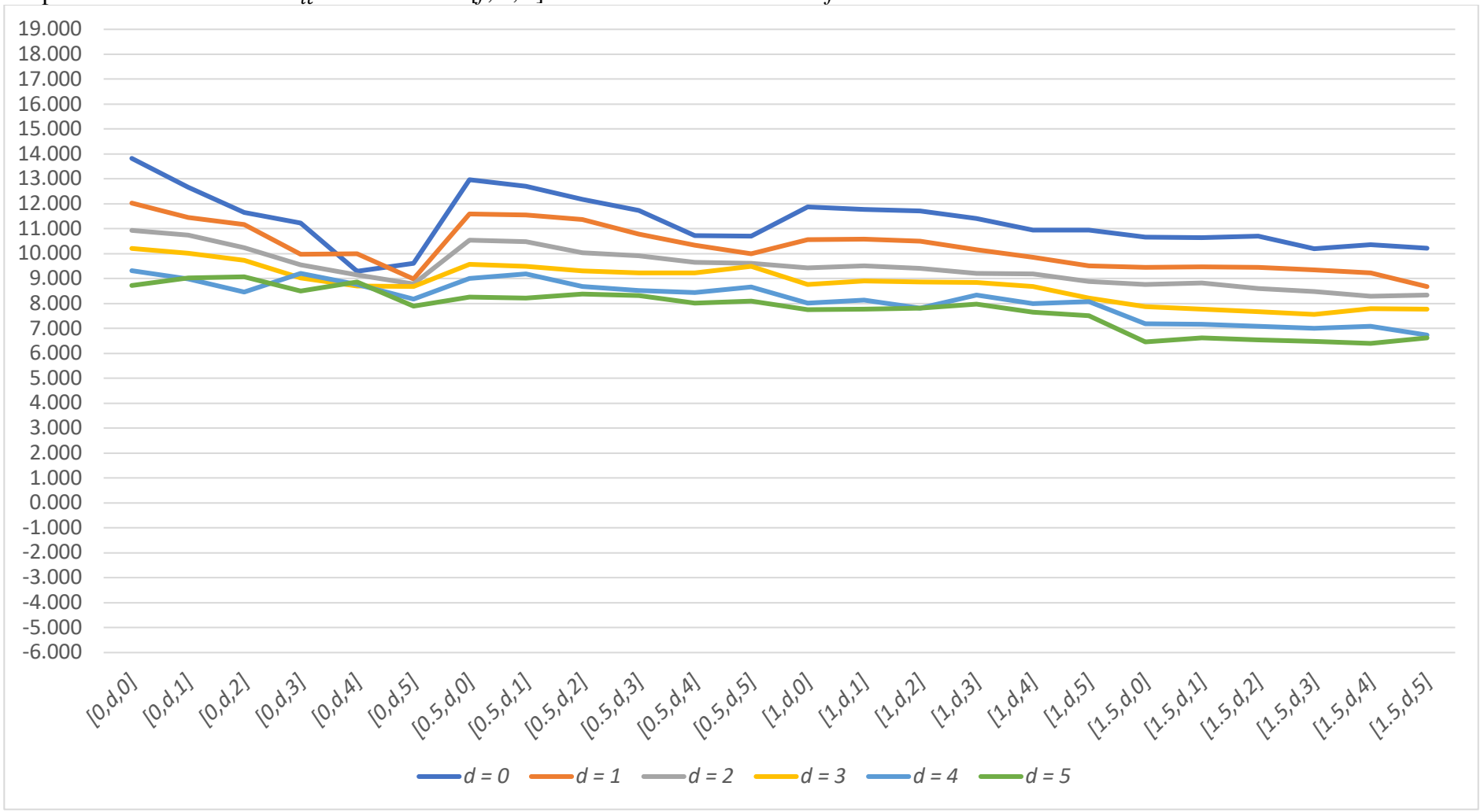
**Appendix 125: VW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



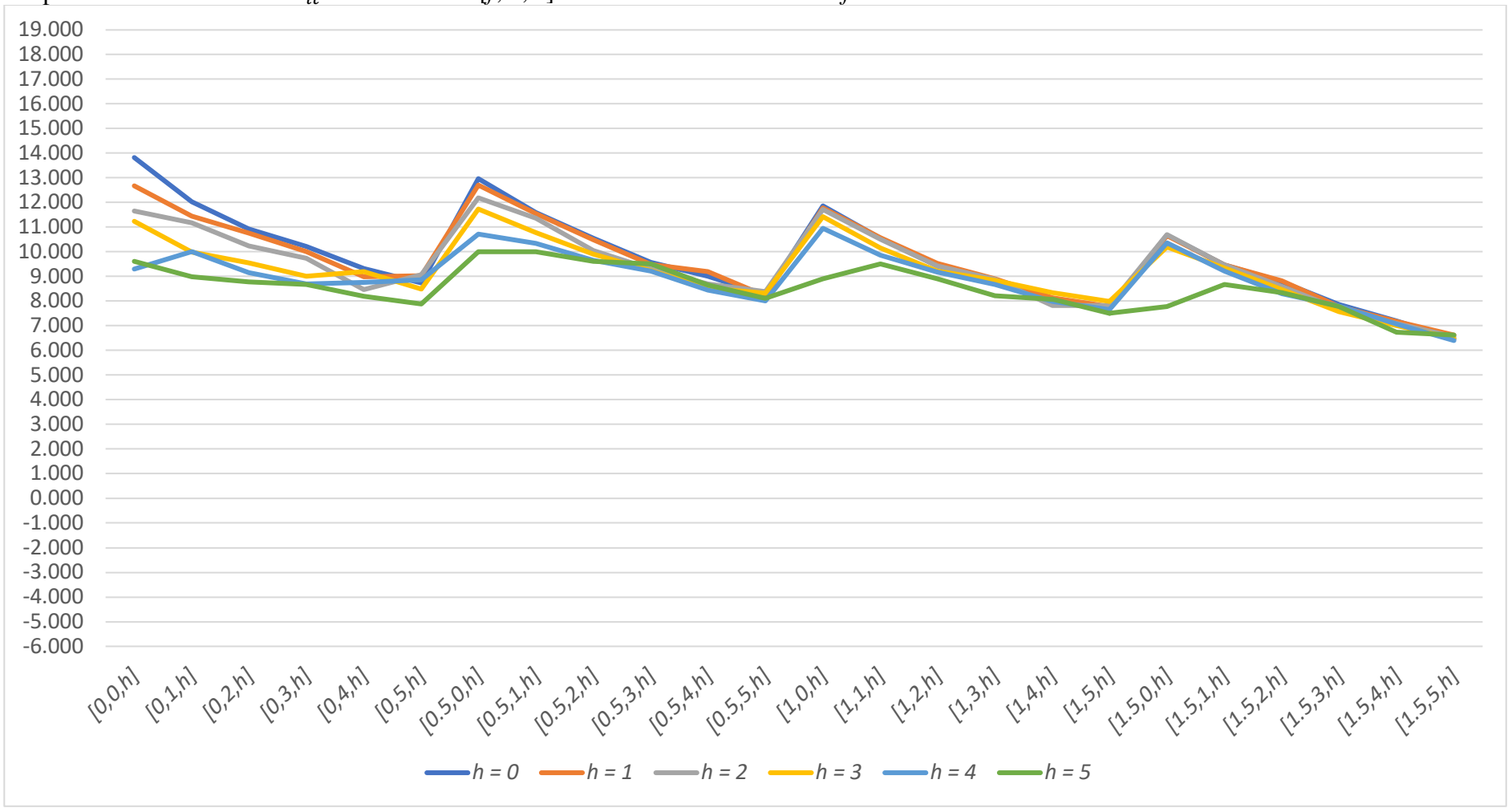
**Appendix 126: VW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 127: VW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 128: VW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.824*** | 12.673*** | 11.655*** | 11.234*** | 9.296*** | 9.623*** |
| 1 | 12.031*** | 11.455*** | 11.173*** | 9.981*** | 10.000*** | 8.982*** |
| 2 | 10.935*** | 10.753*** | 10.241*** | 9.555*** | 9.149*** | 8.786*** |
| 3 | 10.211*** | 10.017*** | 9.735*** | 9.018*** | 8.696*** | 8.675*** |
| 4 | 9.319*** | 8.985*** | 8.471*** | 9.203*** | 8.768*** | 8.189*** |
| 5 | 8.729*** | 9.023*** | 9.073*** | 8.493*** | 8.871*** | 7.889*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.969*** | 12.707*** | 12.190*** | 11.735*** | 10.726*** | 10.700*** |
| 1 | 11.585*** | 11.552*** | 11.370*** | 10.790*** | 10.334*** | 10.004*** |
| 2 | 10.544*** | 10.481*** | 10.046*** | 9.912*** | 9.662*** | 9.624*** |
| 3 | 9.577*** | 9.499*** | 9.310*** | 9.239*** | 9.225*** | 9.501*** |
| 4 | 9.014*** | 9.194*** | 8.694*** | 8.529*** | 8.449*** | 8.666*** |
| 5 | 8.256*** | 8.211*** | 8.375*** | 8.319*** | 8.015*** | 8.104*** |

***f = 1***

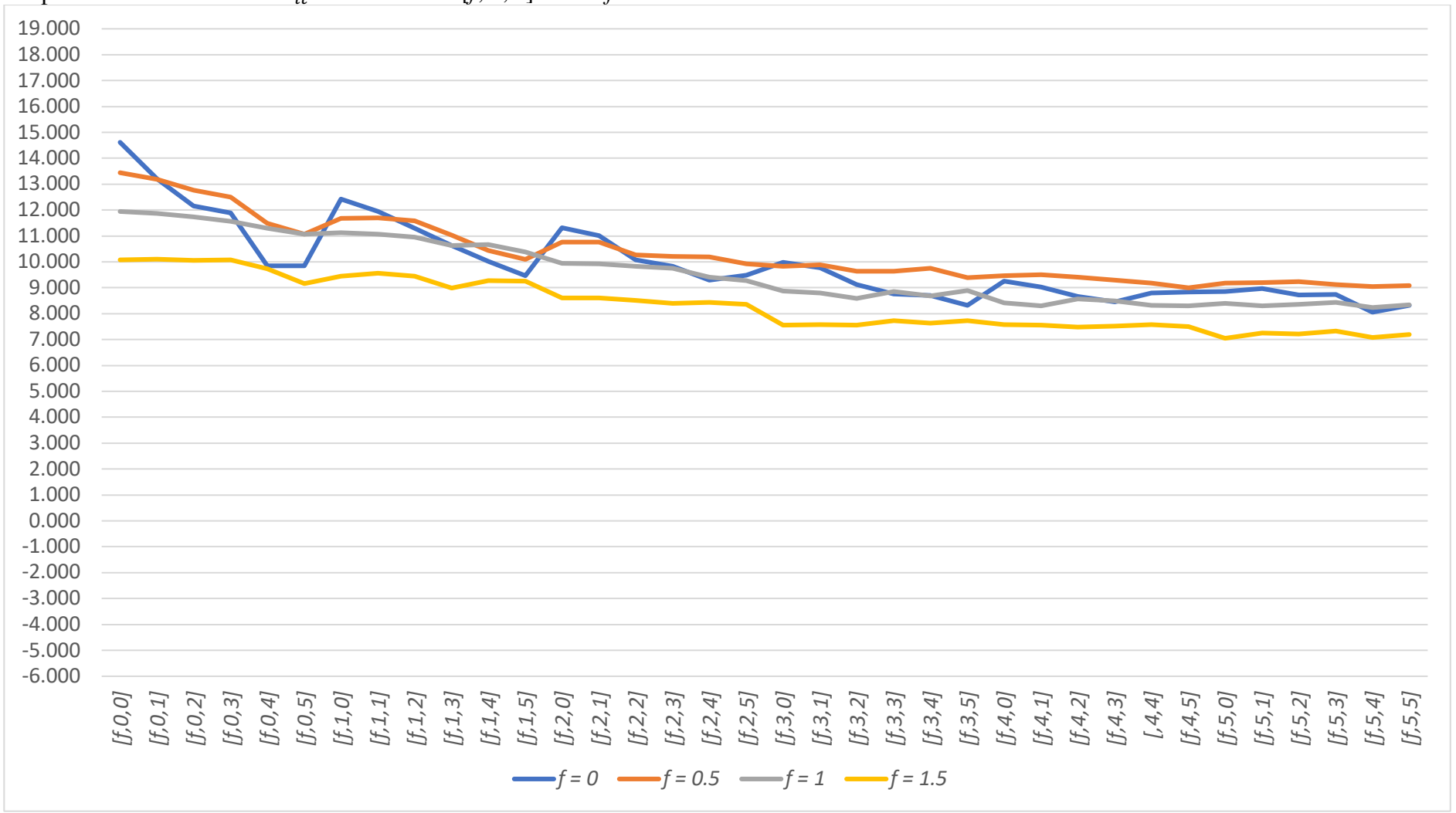
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.868*** | 12.031*** | 11.455*** | 11.173*** | 9.981*** | 10.000*** |
| 1 | 10.561*** | 10.579*** | 10.508*** | 10.153*** | 9.854*** | 9.518*** |
| 2 | 9.423*** | 9.521*** | 9.418*** | 9.217*** | 9.184*** | 8.896*** |
| 3 | 8.759*** | 8.914*** | 8.876*** | 8.839*** | 8.683*** | 8.225*** |
| 4 | 8.025*** | 8.142*** | 7.814*** | 8.345*** | 7.998*** | 8.082*** |
| 5 | 7.763*** | 7.773*** | 7.822*** | 7.981*** | 7.664*** | 7.504*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.674*** | 11.585*** | 11.552*** | 11.370*** | 10.790*** | 10.334*** |
| 1 | 9.462*** | 9.477*** | 9.459*** | 9.347*** | 9.224*** | 8.681*** |
| 2 | 8.774*** | 8.826*** | 8.603*** | 8.476*** | 8.294*** | 8.351*** |
| 3 | 7.874*** | 7.783*** | 7.680*** | 7.565*** | 7.794*** | 7.772*** |
| 4 | 7.192*** | 7.179*** | 7.089*** | 7.010*** | 7.081*** | 6.736*** |
| 5 | 6.468*** | 6.625*** | 6.551*** | 6.484*** | 6.402*** | 6.625*** |

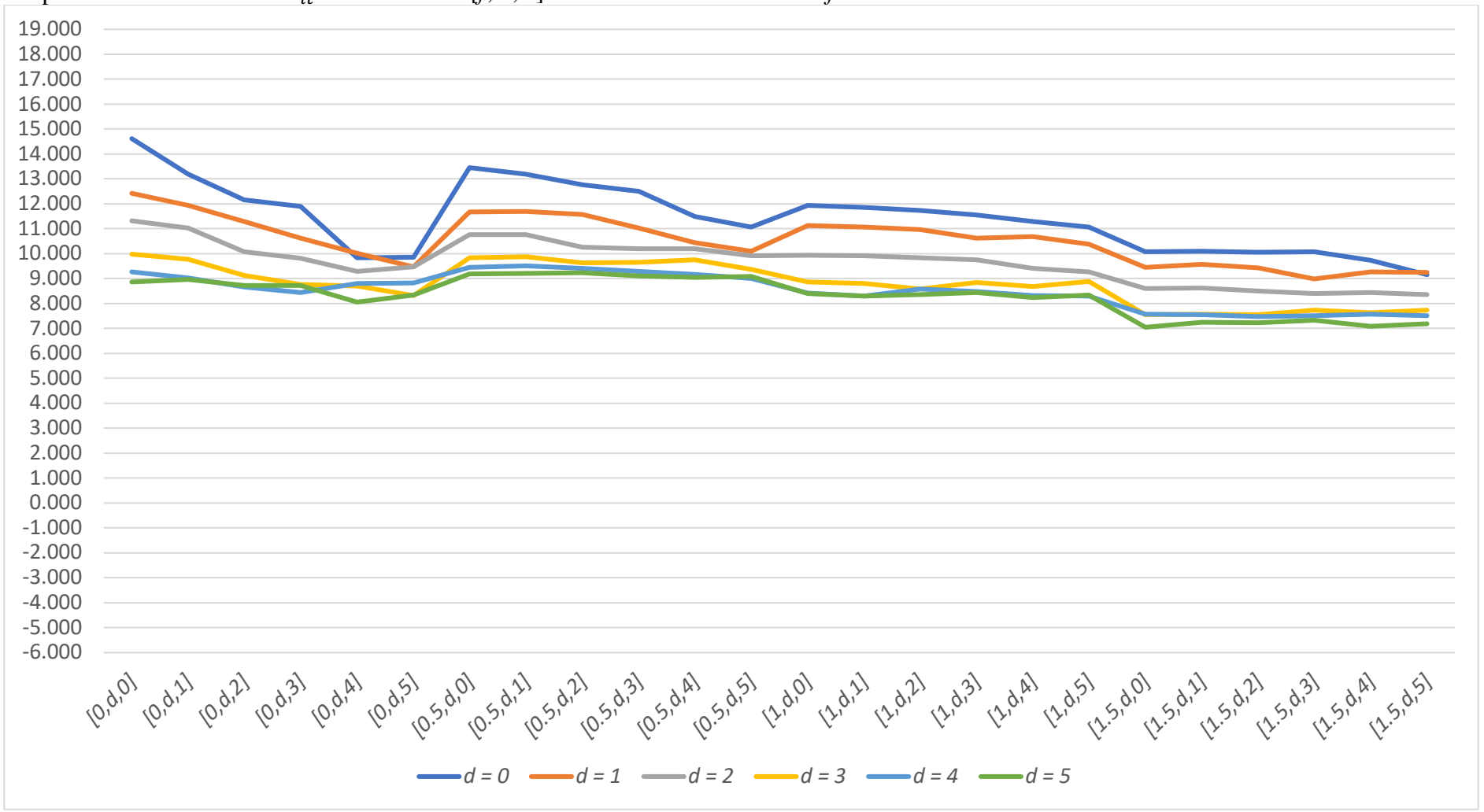
**Appendix 129: VW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



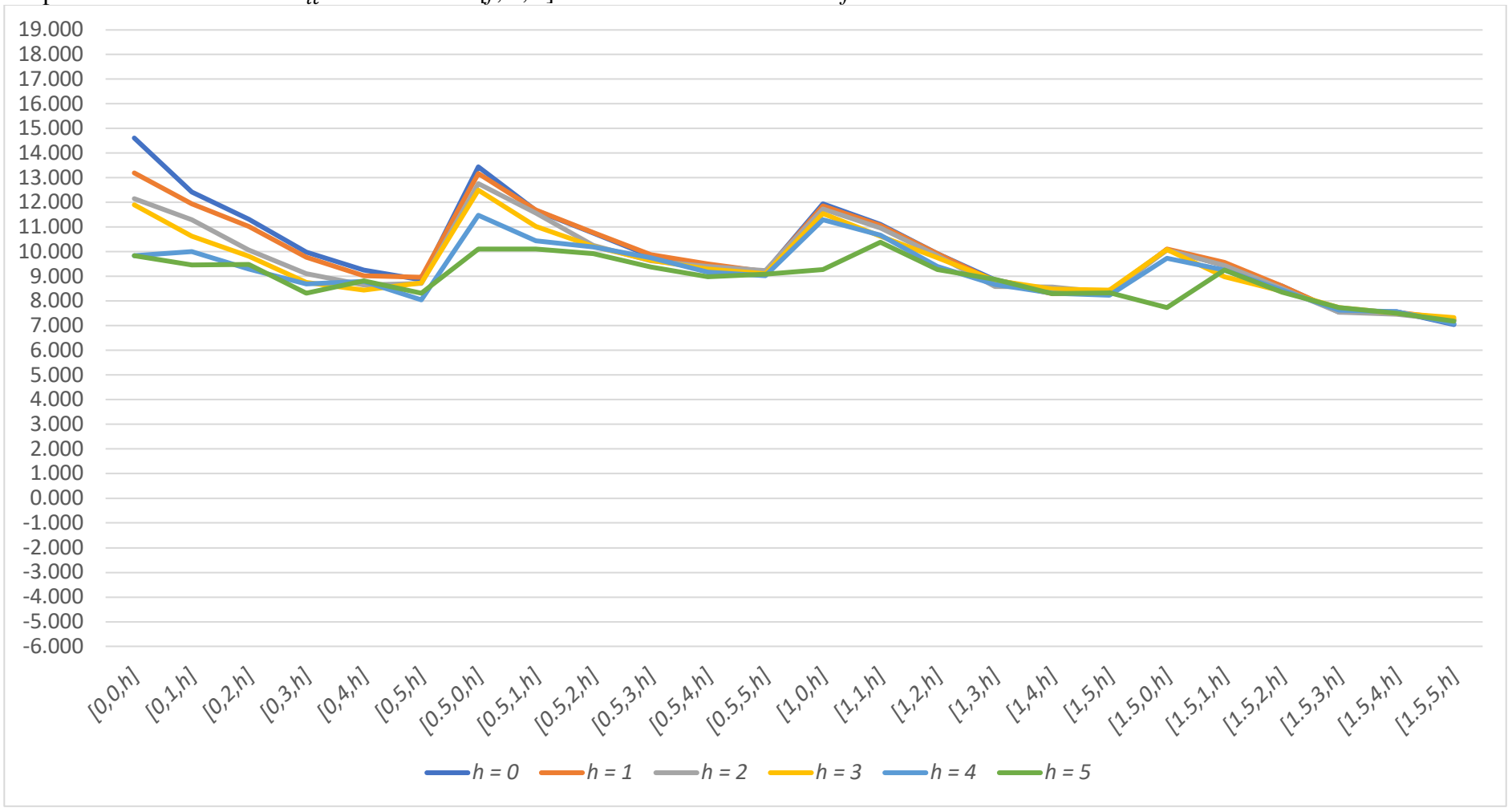
**Appendix 130: VW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 131: VW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 132: VW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.616*** | 13.200*** | 12.151*** | 11.897*** | 9.846*** | 9.848*** |
| 1 | 12.422*** | 11.939*** | 11.294*** | 10.634*** | 10.011*** | 9.475*** |
| 2 | 11.319*** | 11.022*** | 10.078*** | 9.824*** | 9.300*** | 9.482*** |
| 3 | 9.981*** | 9.779*** | 9.122*** | 8.759*** | 8.705*** | 8.316*** |
| 4 | 9.266*** | 9.033*** | 8.658*** | 8.448*** | 8.805*** | 8.828*** |
| 5 | 8.862*** | 8.964*** | 8.722*** | 8.733*** | 8.057*** | 8.331*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.443*** | 13.183*** | 12.767*** | 12.502*** | 11.483*** | 11.063*** |
| 1 | 11.677*** | 11.693*** | 11.580*** | 11.029*** | 10.449*** | 10.105*** |
| 2 | 10.764*** | 10.771*** | 10.259*** | 10.208*** | 10.198*** | 9.924*** |
| 3 | 9.830*** | 9.885*** | 9.642*** | 9.647*** | 9.758*** | 9.381*** |
| 4 | 9.459*** | 9.513*** | 9.409*** | 9.296*** | 9.174*** | 8.999*** |
| 5 | 9.188*** | 9.201*** | 9.235*** | 9.116*** | 9.039*** | 9.086*** |

***f = 1***

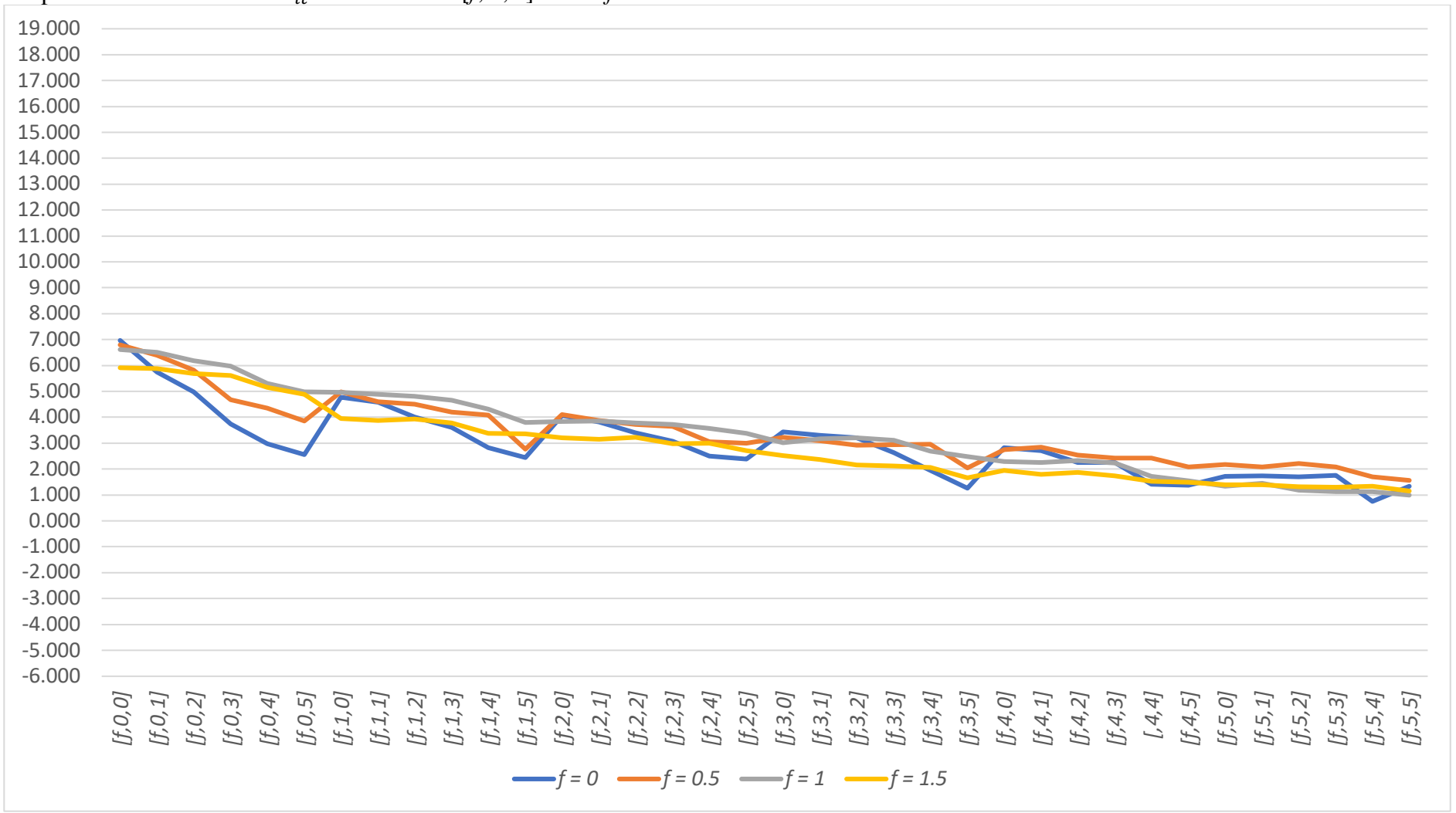
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.946*** | 12.422*** | 11.939*** | 11.294*** | 10.634*** | 10.011*** |
| 1 | 11.122*** | 11.063*** | 10.958*** | 10.626*** | 10.675*** | 10.390*** |
| 2 | 9.935*** | 9.923*** | 9.836*** | 9.750*** | 9.410*** | 9.280*** |
| 3 | 8.872*** | 8.803*** | 8.586*** | 8.852*** | 8.675*** | 8.890*** |
| 4 | 8.413*** | 8.309*** | 8.575*** | 8.485*** | 8.325*** | 8.308*** |
| 5 | 8.401*** | 8.302*** | 8.352*** | 8.438*** | 8.238*** | 8.334*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.087*** | 11.677*** | 11.693*** | 11.580*** | 11.029*** | 10.449*** |
| 1 | 9.457*** | 9.565*** | 9.441*** | 8.988*** | 9.270*** | 9.254*** |
| 2 | 8.604*** | 8.616*** | 8.508*** | 8.399*** | 8.444*** | 8.359*** |
| 3 | 7.554*** | 7.571*** | 7.553*** | 7.733*** | 7.635*** | 7.733*** |
| 4 | 7.570*** | 7.552*** | 7.477*** | 7.516*** | 7.580*** | 7.505*** |
| 5 | 7.050*** | 7.259*** | 7.223*** | 7.333*** | 7.088*** | 7.189*** |

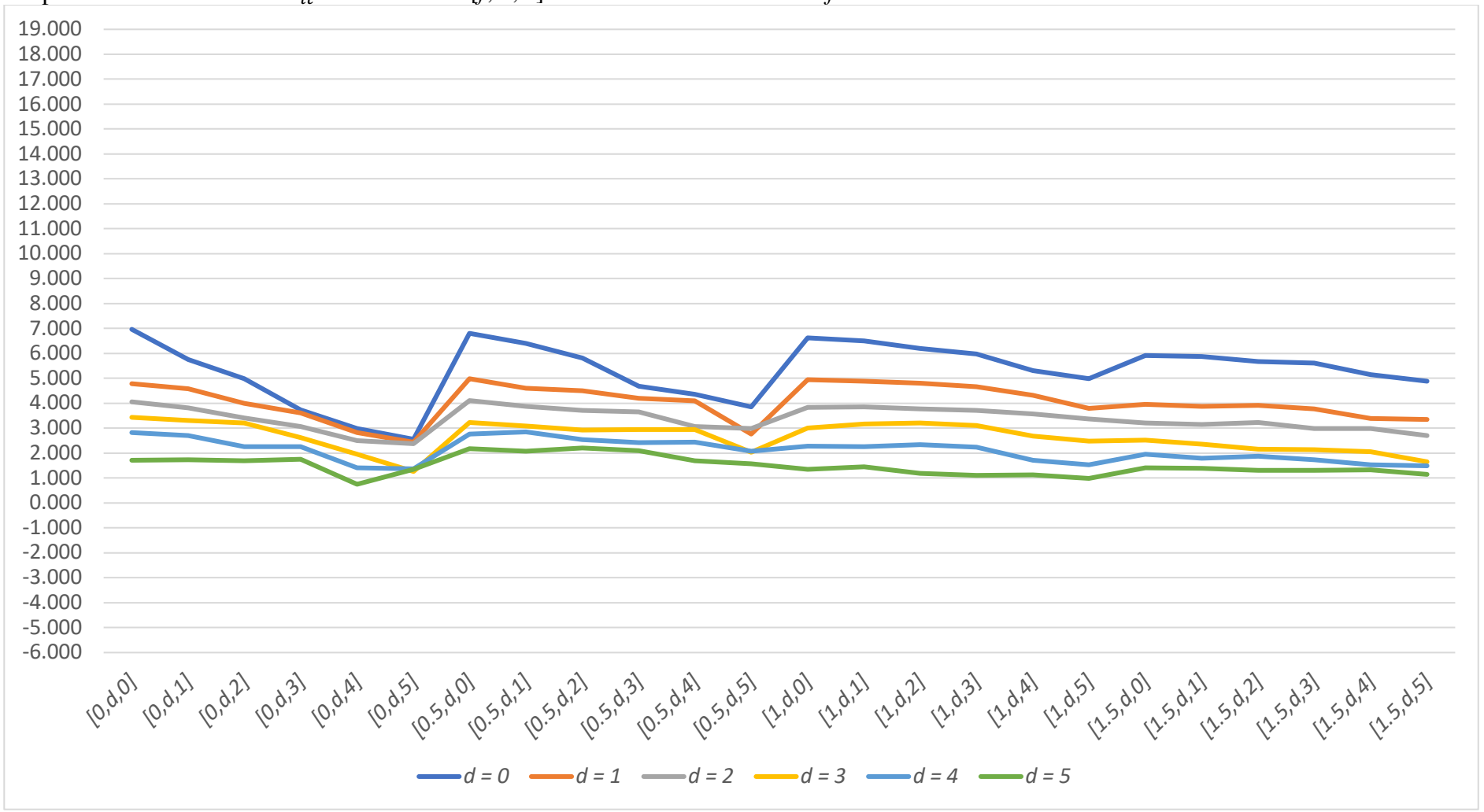
**Appendix 133: EW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



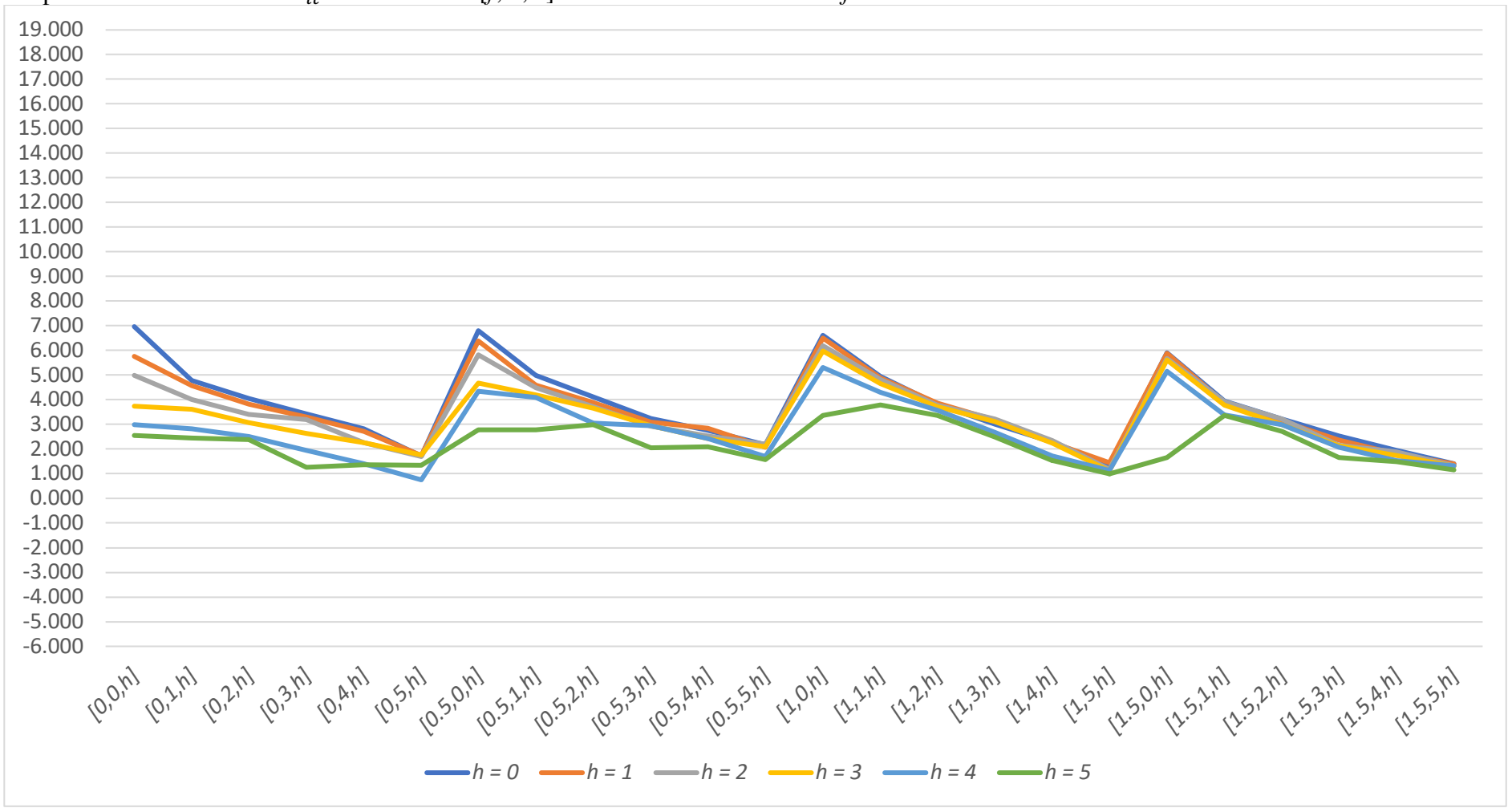
**Appendix 134: EW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 135: EW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 136: EW Asia Pacific excl. Japan S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.967*** | 5.755*** | 4.981*** | 3.740** | 2.983* | 2.557 |
| 1 | 4.777*** | 4.576*** | 4.005** | 3.609** | 2.827* | 2.438 |
| 2 | 4.059** | 3.813** | 3.404** | 3.069* | 2.510 | 2.379 |
| 3 | 3.436** | 3.311** | 3.205* | 2.626 | 1.952 | 1.265 |
| 4 | 2.821* | 2.711 | 2.260 | 2.255 | 1.414 | 1.370 |
| 5 | 1.715 | 1.738 | 1.701 | 1.759 | 0.751 | 1.346 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.796*** | 6.394*** | 5.823*** | 4.686*** | 4.353*** | 3.864** |
| 1 | 4.985*** | 4.596*** | 4.496*** | 4.197*** | 4.092** | 2.771* |
| 2 | 4.109** | 3.881** | 3.723** | 3.646** | 3.059* | 2.997* |
| 3 | 3.231* | 3.098* | 2.918* | 2.947* | 2.950* | 2.046 |
| 4 | 2.759* | 2.852* | 2.534 | 2.427 | 2.434 | 2.084 |
| 5 | 2.172 | 2.080 | 2.207 | 2.091 | 1.693 | 1.563 |

***f = 1***

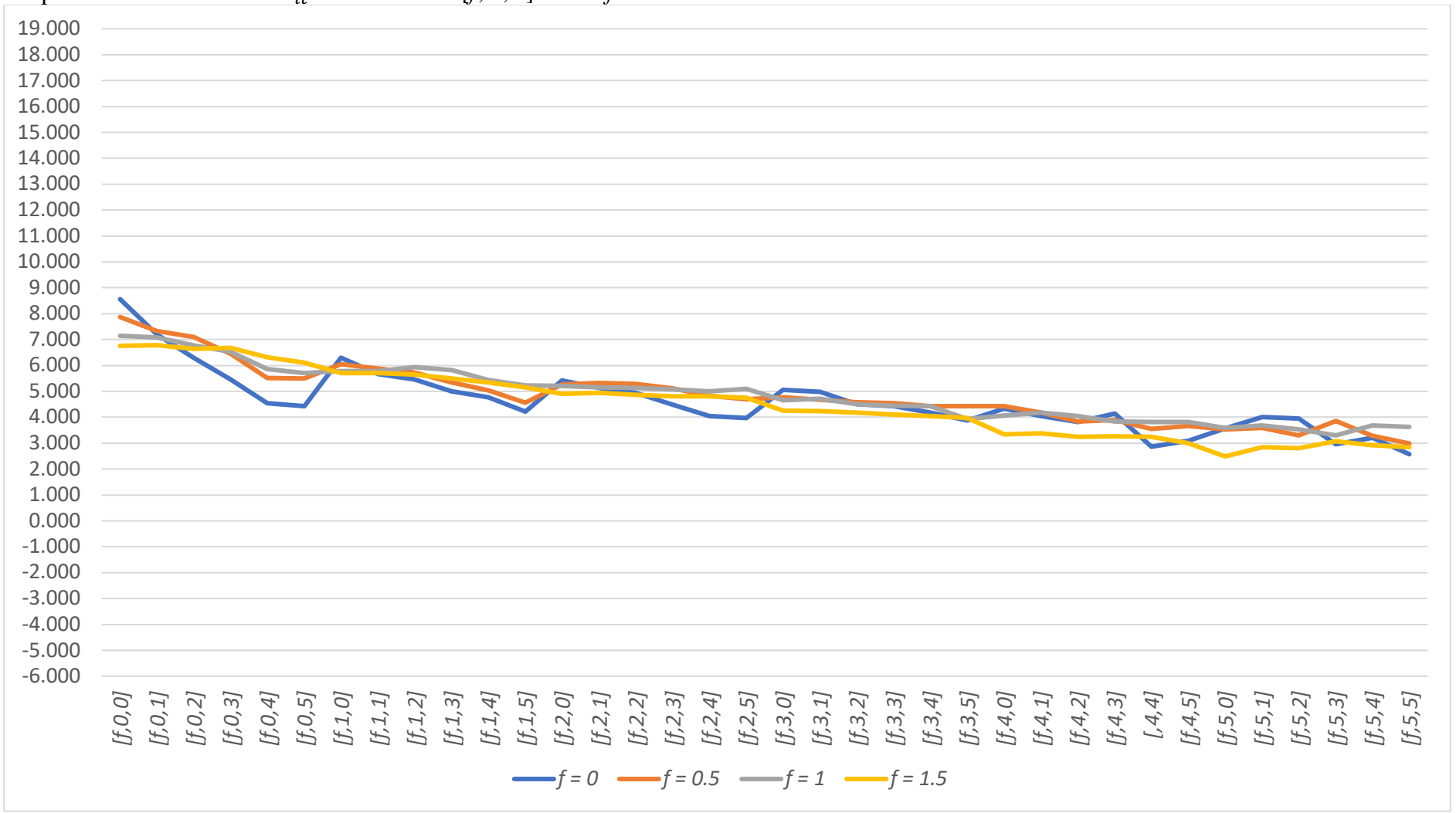
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.615*** | 4.777*** | 4.576*** | 4.005** | 3.609** | 2.827* |
| 1 | 4.955*** | 4.890*** | 4.815*** | 4.659*** | 4.312*** | 3.790** |
| 2 | 3.833** | 3.858** | 3.775** | 3.720** | 3.568** | 3.370** |
| 3 | 3.015* | 3.173* | 3.216* | 3.109* | 2.684 | 2.491 |
| 4 | 2.287 | 2.261 | 2.334 | 2.239 | 1.720 | 1.538 |
| 5 | 1.344 | 1.458 | 1.180 | 1.118 | 1.131 | 0.994 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.912*** | 4.985*** | 4.596*** | 4.496*** | 4.197*** | 4.092** |
| 1 | 3.955** | 3.873** | 3.924** | 3.781** | 3.384** | 3.359** |
| 2 | 3.212* | 3.143* | 3.221* | 2.980* | 2.995* | 2.710* |
| 3 | 2.523 | 2.367 | 2.163 | 2.129 | 2.065 | 1.653 |
| 4 | 1.947 | 1.803 | 1.881 | 1.742 | 1.526 | 1.499 |
| 5 | 1.401 | 1.399 | 1.319 | 1.308 | 1.332 | 1.153 |

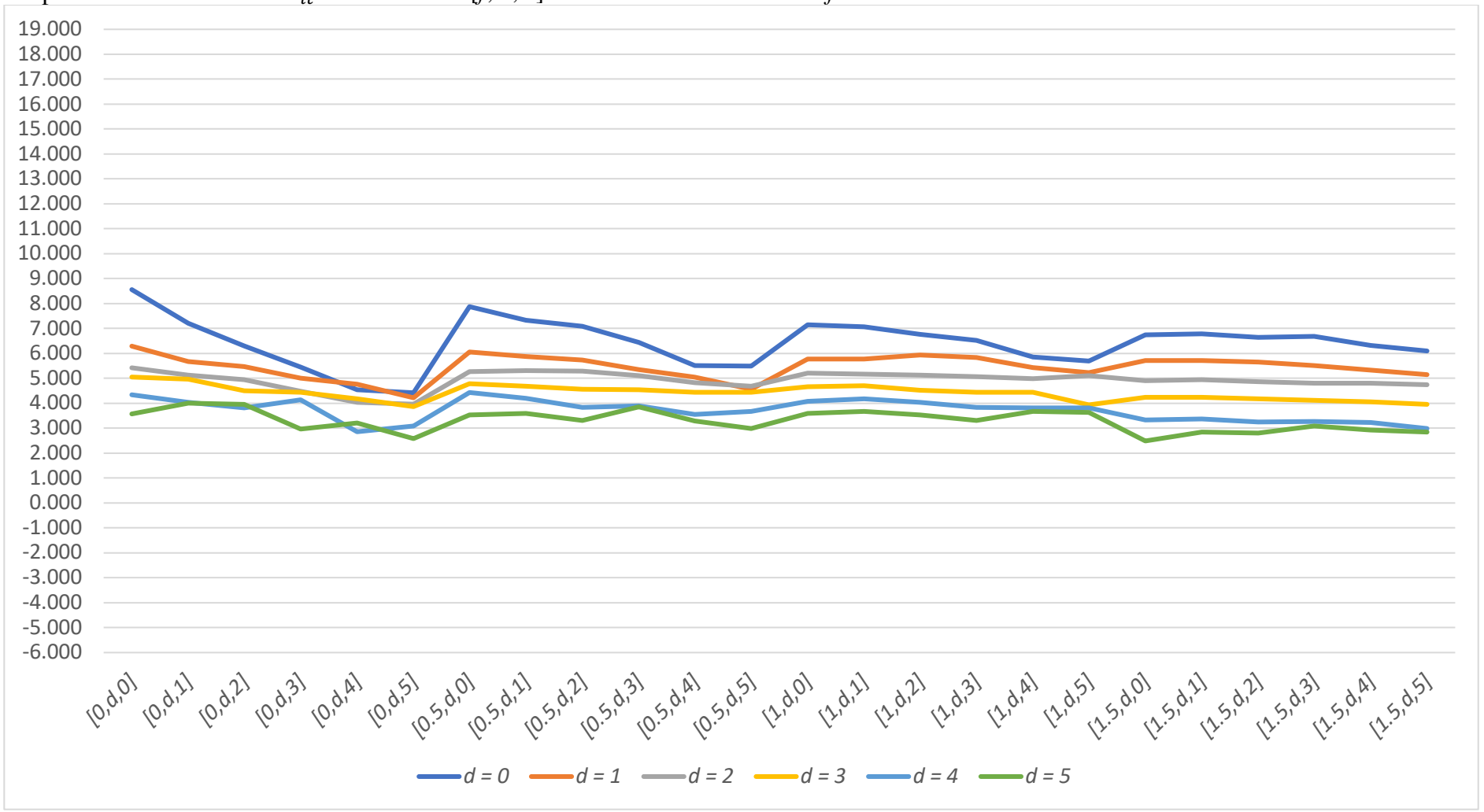
**Appendix 137: EW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



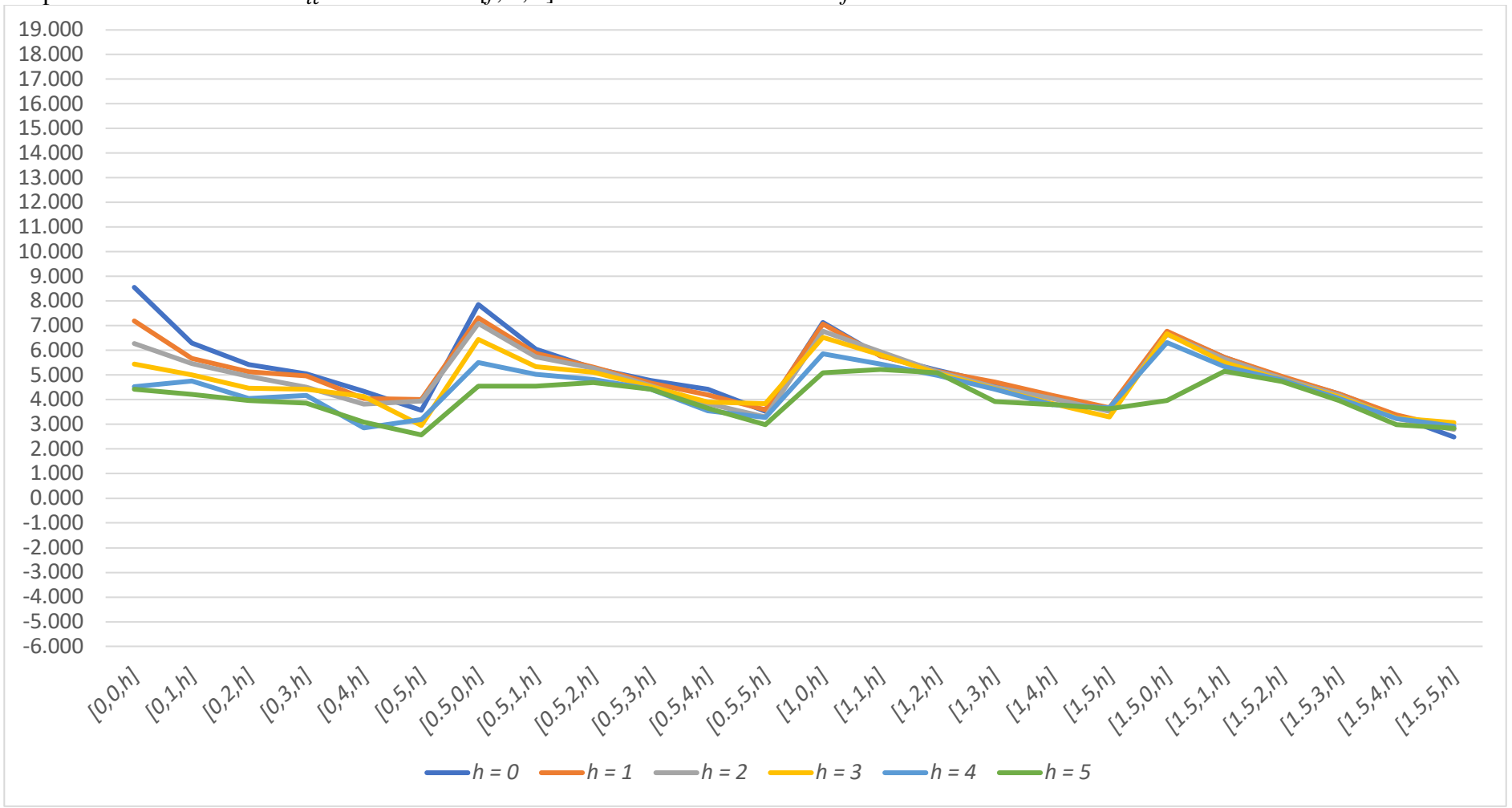
**Appendix 138: EW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 139: EW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 140: EW Asia Pacific excl. Japan S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.560*** | 7.203*** | 6.291*** | 5.453*** | 4.535*** | 4.422*** |
| 1 | 6.292*** | 5.676*** | 5.467*** | 5.008*** | 4.765*** | 4.221*** |
| 2 | 5.423*** | 5.138*** | 4.938*** | 4.477*** | 4.043*** | 3.964*** |
| 3 | 5.052*** | 4.977*** | 4.512*** | 4.435*** | 4.173*** | 3.866** |
| 4 | 4.336*** | 4.043*** | 3.817** | 4.143*** | 2.858* | 3.092** |
| 5 | 3.575** | 4.005*** | 3.951** | 2.957* | 3.208** | 2.575* |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.870*** | 7.321*** | 7.094*** | 6.444*** | 5.509*** | 5.490*** |
| 1 | 6.060*** | 5.880*** | 5.733*** | 5.349*** | 5.039*** | 4.560*** |
| 2 | 5.273*** | 5.319*** | 5.285*** | 5.111*** | 4.825*** | 4.693*** |
| 3 | 4.781*** | 4.686*** | 4.572*** | 4.540*** | 4.437*** | 4.436*** |
| 4 | 4.432*** | 4.190*** | 3.844** | 3.896** | 3.550** | 3.664** |
| 5 | 3.528** | 3.584** | 3.308** | 3.848** | 3.285** | 2.988* |

***f = 1***

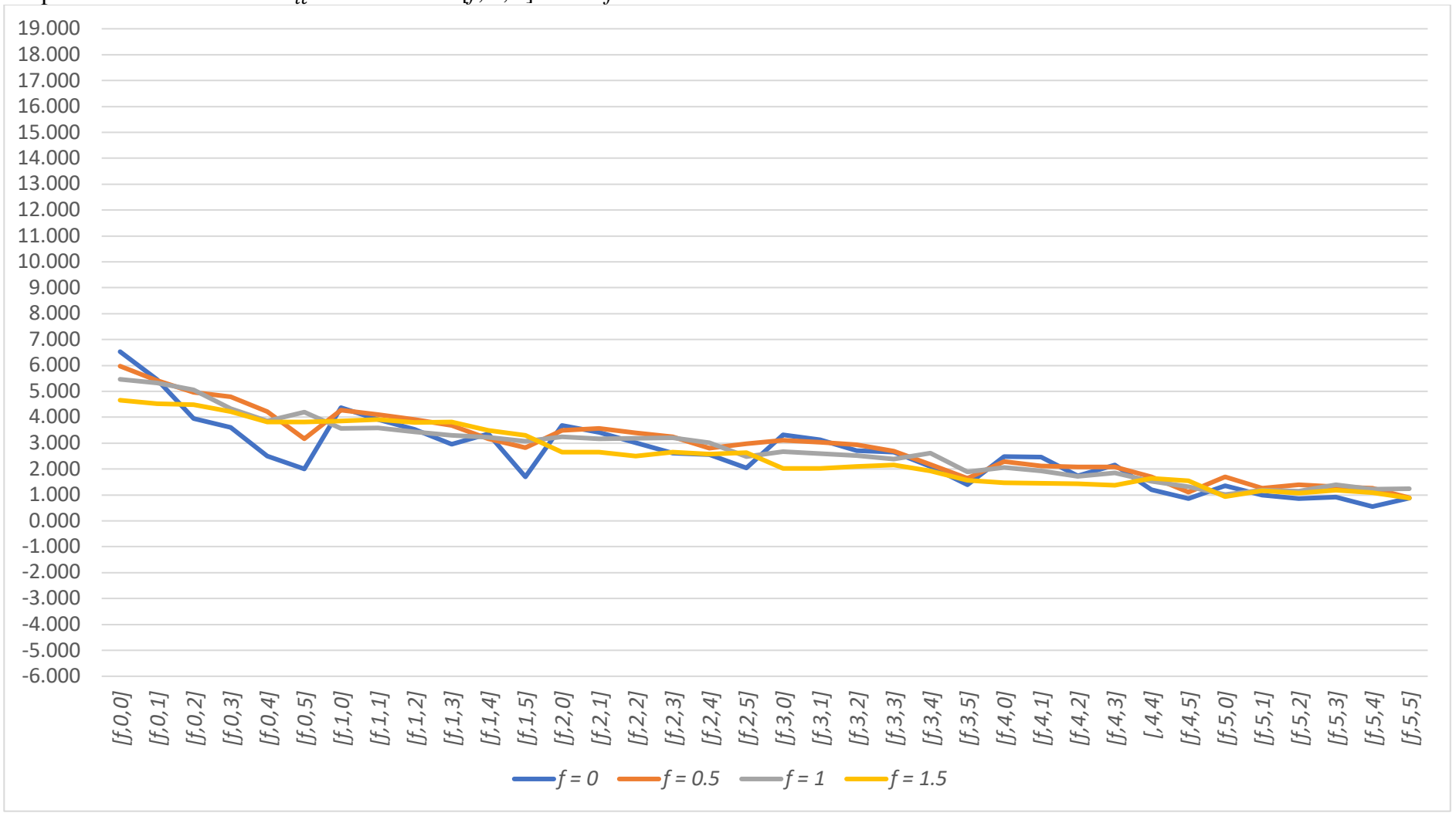
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.145*** | 6.292*** | 5.676*** | 5.467*** | 5.008*** | 4.765*** |
| 1 | 5.777*** | 5.781*** | 5.945*** | 5.826*** | 5.438*** | 5.229*** |
| 2 | 5.207*** | 5.163*** | 5.138*** | 5.075*** | 4.997*** | 5.102*** |
| 3 | 4.657*** | 4.710*** | 4.514*** | 4.450*** | 4.434*** | 3.929** |
| 4 | 4.072** | 4.184*** | 4.045** | 3.842** | 3.810** | 3.810** |
| 5 | 3.595** | 3.682** | 3.536** | 3.301** | 3.678** | 3.632** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.749*** | 6.060*** | 5.880*** | 5.733*** | 5.349*** | 5.039*** |
| 1 | 5.715*** | 5.710*** | 5.653*** | 5.507*** | 5.337*** | 5.148*** |
| 2 | 4.902*** | 4.942*** | 4.874*** | 4.811*** | 4.808*** | 4.747*** |
| 3 | 4.249*** | 4.239*** | 4.176*** | 4.111*** | 4.054** | 3.965** |
| 4 | 3.340** | 3.375** | 3.243** | 3.266** | 3.238** | 2.989* |
| 5 | 2.489 | 2.840* | 2.799* | 3.078** | 2.917* | 2.847* |

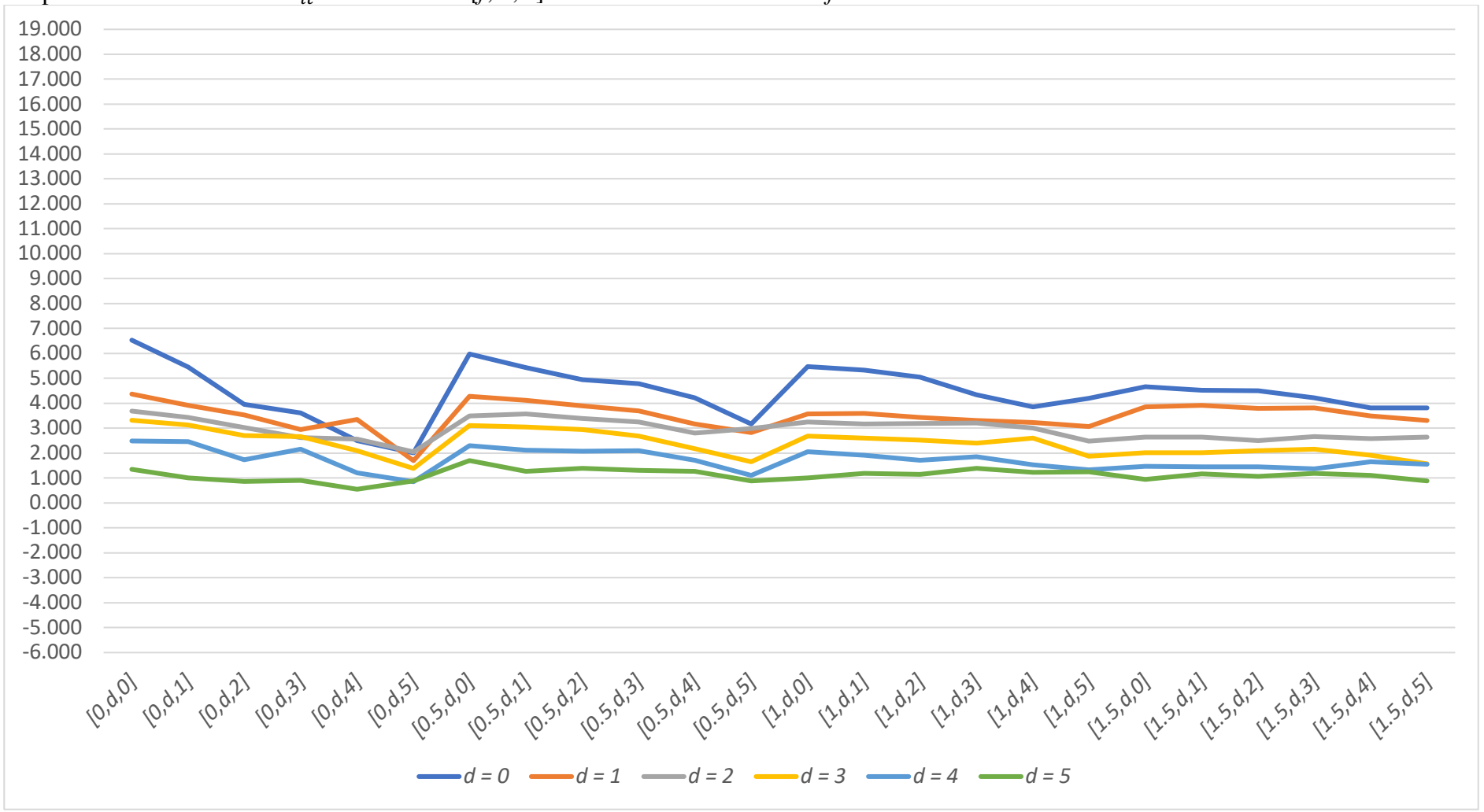
**Appendix 141: EW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



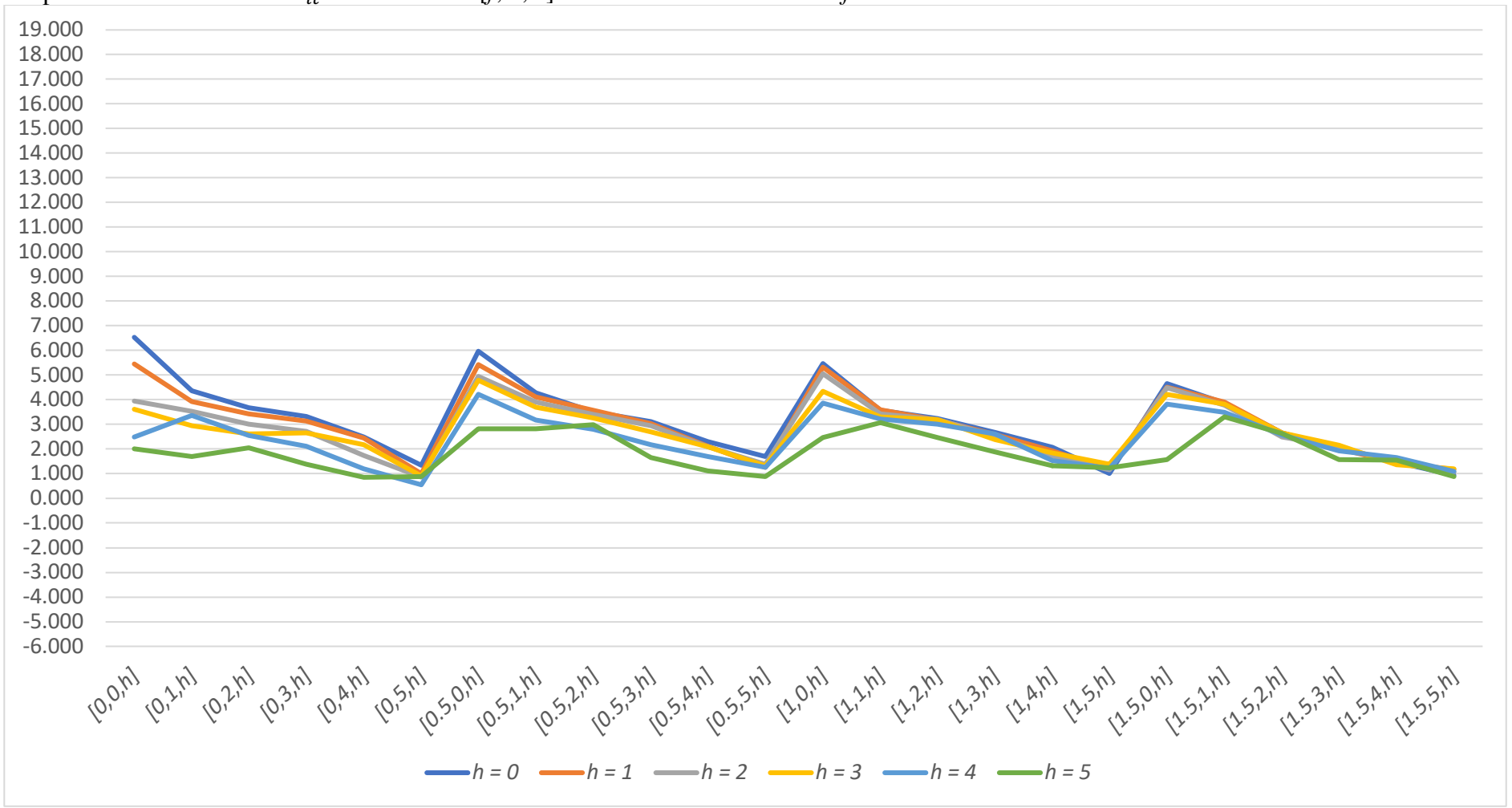
**Appendix 142: EW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 143: EW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 144: EW Asia Pacific excl. Japan S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.533*** | 5.452*** | 3.954*** | 3.611** | 2.493* | 2.011 |
| 1 | 4.370*** | 3.918*** | 3.534** | 2.955** | 3.358** | 1.698 |
| 2 | 3.687** | 3.424** | 3.018** | 2.620* | 2.554* | 2.051 |
| 3 | 3.319** | 3.136** | 2.710* | 2.661* | 2.104 | 1.386 |
| 4 | 2.488* | 2.454* | 1.741 | 2.167 | 1.206 | 0.855 |
| 5 | 1.348 | 1.001 | 0.862 | 0.911 | 0.552 | 0.880 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.974*** | 5.425*** | 4.956*** | 4.791*** | 4.222*** | 3.171** |
| 1 | 4.285*** | 4.113*** | 3.905*** | 3.690** | 3.173** | 2.826** |
| 2 | 3.500** | 3.567** | 3.397** | 3.254** | 2.799* | 2.984** |
| 3 | 3.108** | 3.039** | 2.942** | 2.691* | 2.176 | 1.649 |
| 4 | 2.300 | 2.116 | 2.085 | 2.088 | 1.706 | 1.115 |
| 5 | 1.702 | 1.262 | 1.390 | 1.316 | 1.264 | 0.893 |

***f = 1***

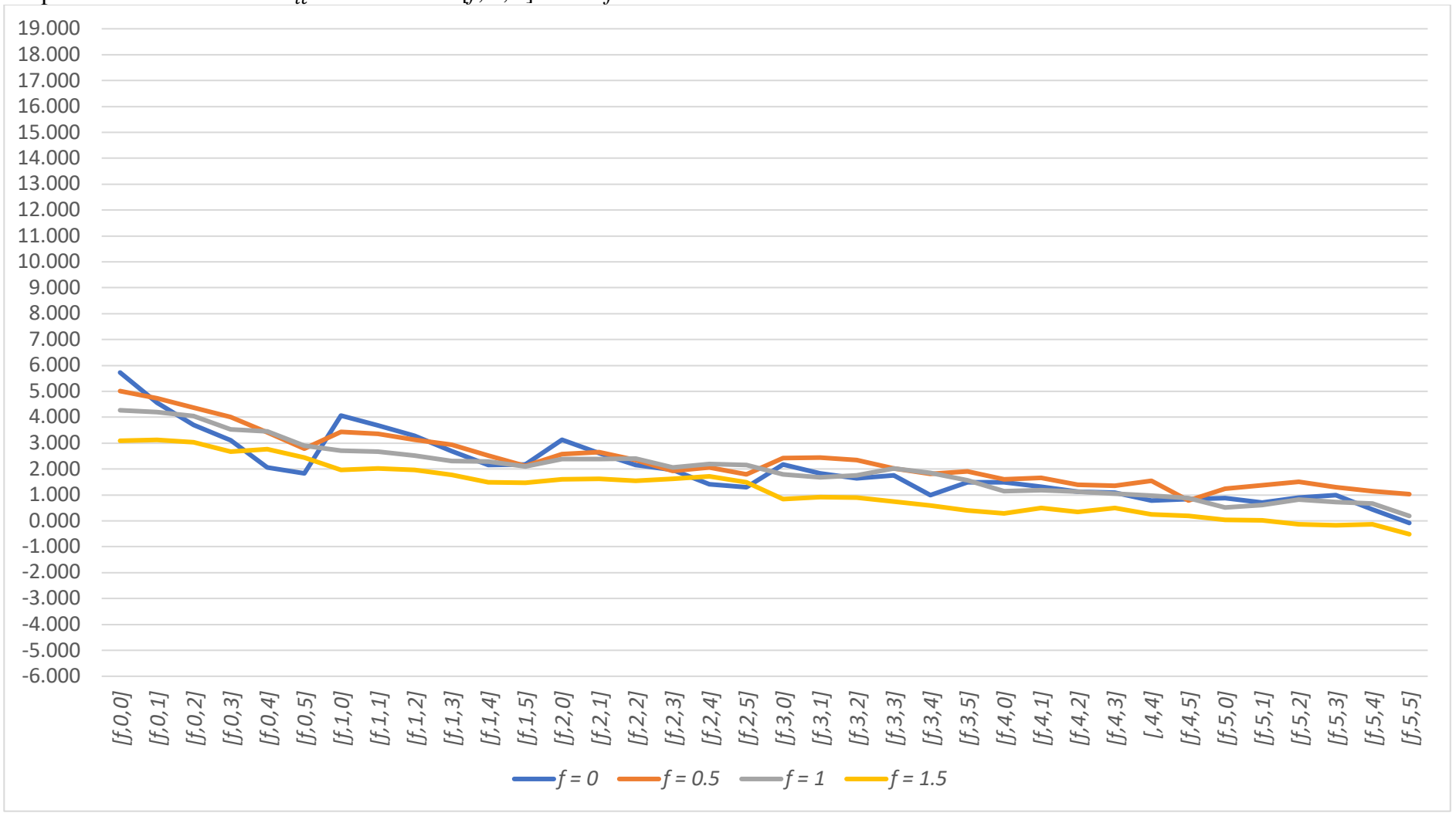
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.466*** | 4.370*** | 3.918*** | 3.534** | 2.955** | 3.358** |
| 1 | 3.564** | 3.593** | 3.434** | 3.310** | 3.224** | 3.068** |
| 2 | 3.241** | 3.169** | 3.196** | 3.208** | 3.008** | 2.475* |
| 3 | 2.682* | 2.593* | 2.527* | 2.393 | 2.612* | 1.885 |
| 4 | 2.067 | 1.922 | 1.713 | 1.852 | 1.527 | 1.322 |
| 5 | 1.016 | 1.186 | 1.148 | 1.391 | 1.222 | 1.243 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.659*** | 4.285*** | 4.113*** | 3.905*** | 3.690** | 3.173** |
| 1 | 3.854*** | 3.913*** | 3.790*** | 3.820*** | 3.488** | 3.307** |
| 2 | 2.647* | 2.646* | 2.492* | 2.661* | 2.573* | 2.641* |
| 3 | 2.022 | 2.020 | 2.102 | 2.150 | 1.921 | 1.564 |
| 4 | 1.469 | 1.443 | 1.442 | 1.371 | 1.650 | 1.549 |
| 5 | 0.937 | 1.173 | 1.076 | 1.188 | 1.098 | 0.881 |

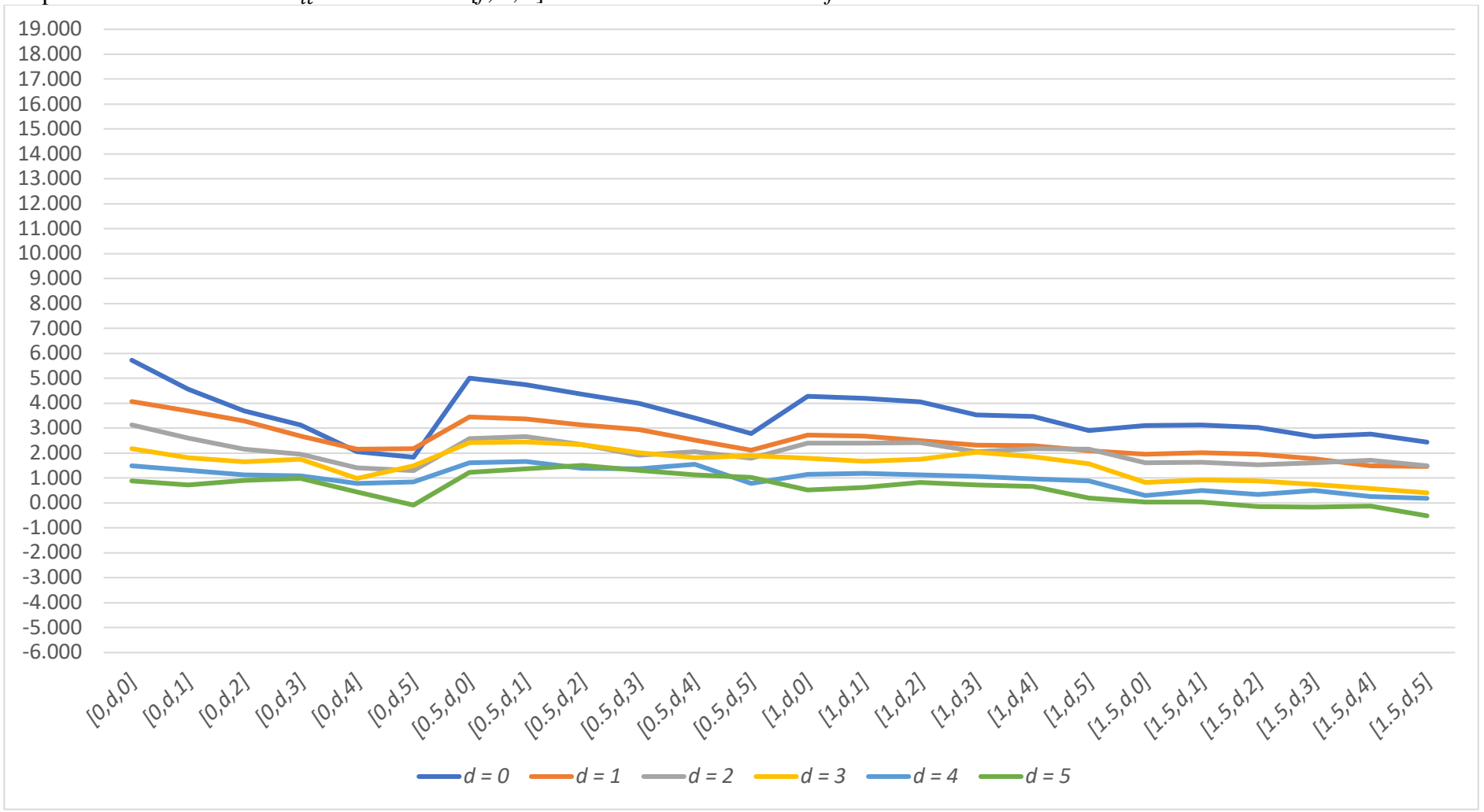
**Appendix 145: EW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



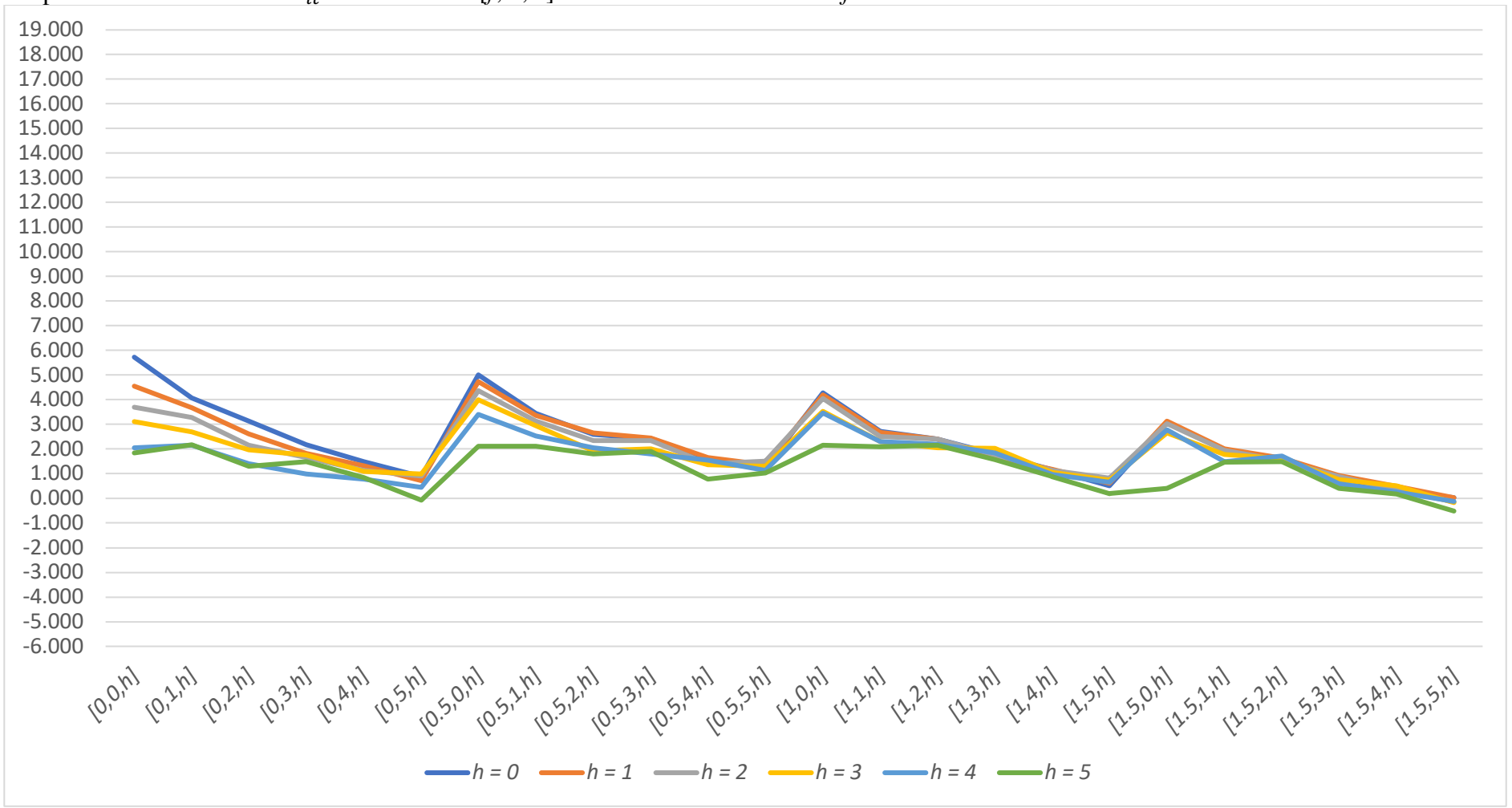
**Appendix 146: EW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 147: EW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 148: EW Asia Pacific excl. Japan S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.728*** | 4.556*** | 3.702*** | 3.119** | 2.056 | 1.836 |
| 1 | 4.070*** | 3.685*** | 3.285*** | 2.694** | 2.163* | 2.175* |
| 2 | 3.133** | 2.607** | 2.165* | 1.962 | 1.406 | 1.298 |
| 3 | 2.180* | 1.825 | 1.650 | 1.757 | 0.995 | 1.486 |
| 4 | 1.495 | 1.315 | 1.136 | 1.084 | 0.781 | 0.838 |
| 5 | 0.880 | 0.717 | 0.906 | 0.988 | 0.438 | -0.081 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.012*** | 4.736*** | 4.369*** | 4.000*** | 3.408*** | 2.789** |
| 1 | 3.443*** | 3.364*** | 3.131** | 2.943** | 2.528** | 2.111* |
| 2 | 2.587** | 2.660** | 2.345* | 1.926 | 2.059 | 1.802 |
| 3 | 2.431* | 2.448* | 2.346* | 2.019 | 1.812 | 1.901 |
| 4 | 1.605 | 1.664 | 1.397 | 1.363 | 1.545 | 0.786 |
| 5 | 1.239 | 1.374 | 1.508 | 1.303 | 1.138 | 1.030 |

***f = 1***

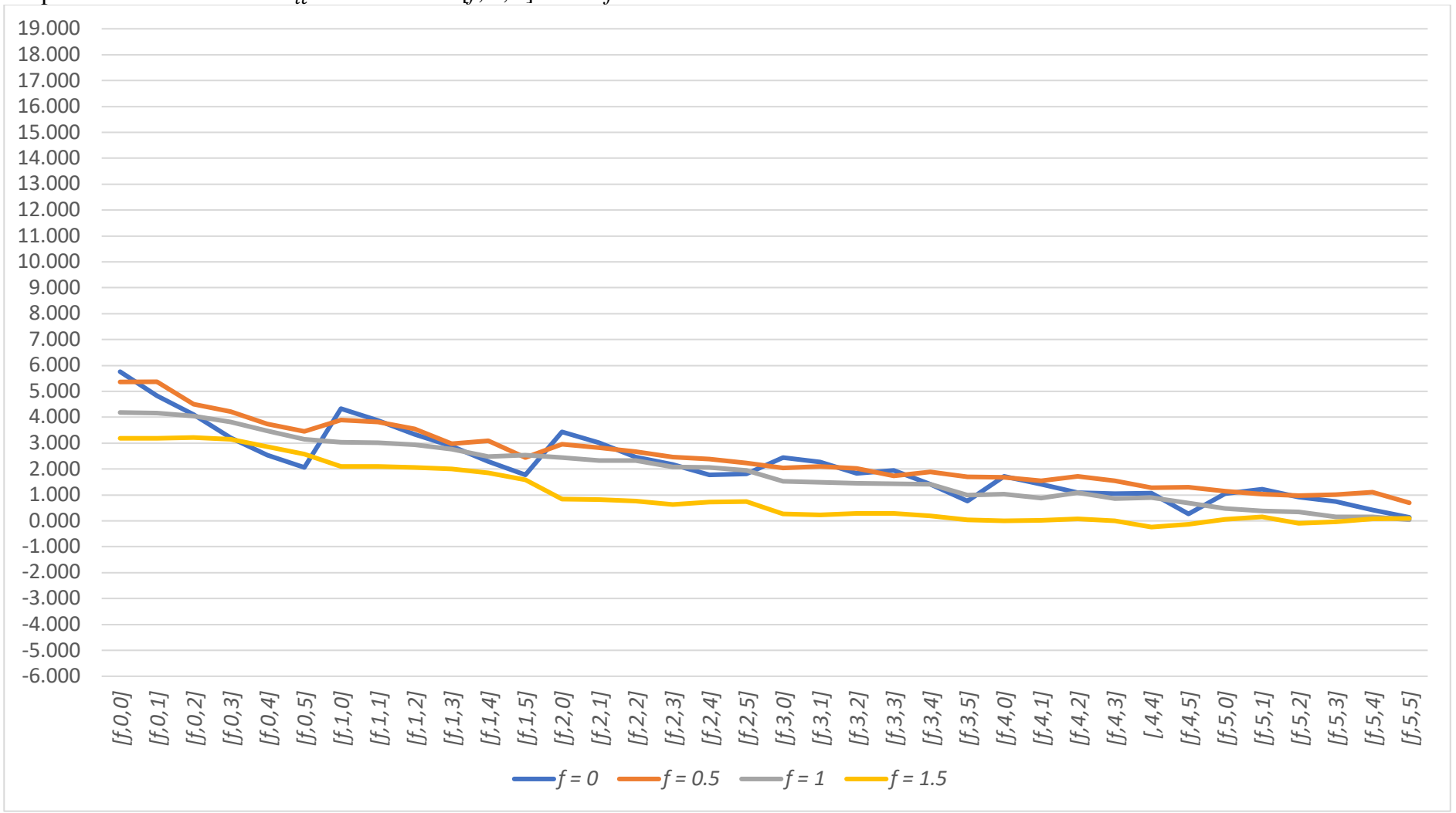
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.271*** | 4.070*** | 3.685*** | 3.285*** | 2.694** | 2.163* |
| 1 | 2.719** | 2.676** | 2.511* | 2.311* | 2.293* | 2.095 |
| 2 | 2.396* | 2.396* | 2.412* | 2.055 | 2.188* | 2.159* |
| 3 | 1.796 | 1.675 | 1.757 | 2.031 | 1.847 | 1.572 |
| 4 | 1.152 | 1.184 | 1.132 | 1.060 | 0.976 | 0.877 |
| 5 | 0.520 | 0.615 | 0.819 | 0.734 | 0.661 | 0.189 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.100** | 3.443*** | 3.364*** | 3.131** | 2.943** | 2.528** |
| 1 | 1.959 | 2.015 | 1.958 | 1.778 | 1.496 | 1.465 |
| 2 | 1.606 | 1.631 | 1.540 | 1.615 | 1.720 | 1.493 |
| 3 | 0.834 | 0.923 | 0.894 | 0.752 | 0.591 | 0.408 |
| 4 | 0.296 | 0.492 | 0.339 | 0.506 | 0.258 | 0.186 |
| 5 | 0.031 | 0.028 | -0.141 | -0.172 | -0.123 | -0.514 |

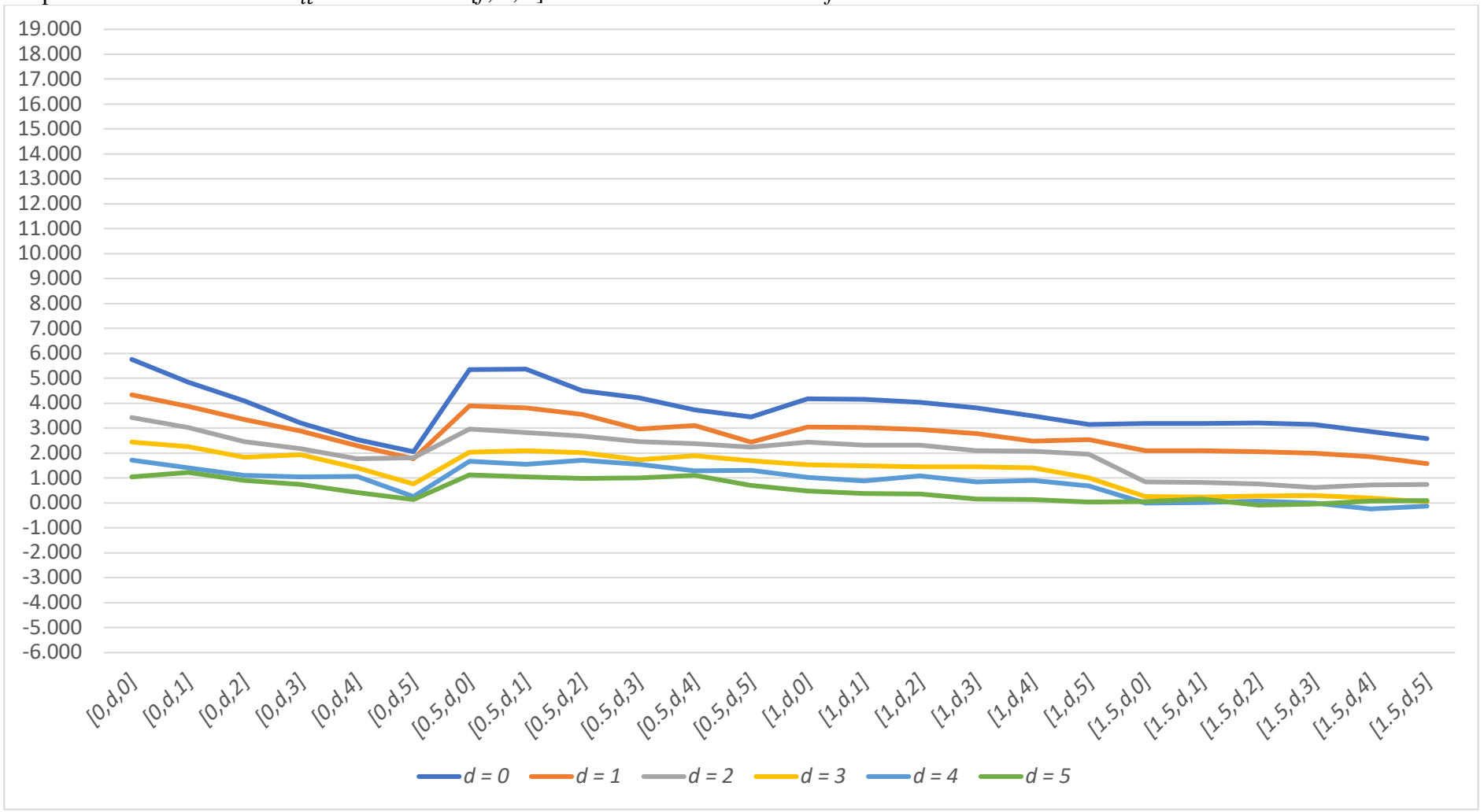
**Appendix 149: EW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



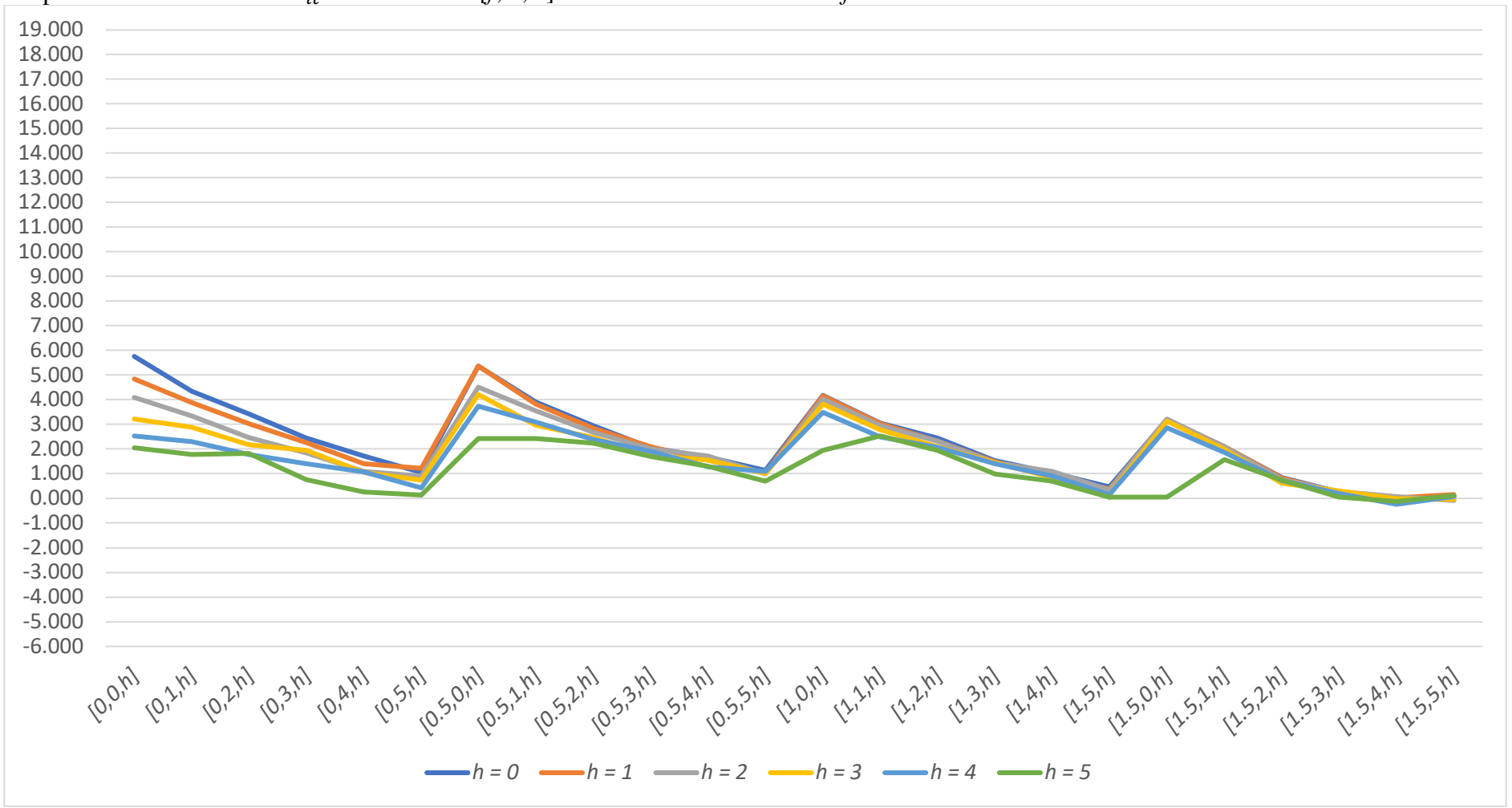
**Appendix 150: EW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 151: EW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 152: EW Asia Pacific excl. Japan S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.760*** | 4.838*** | 4.099*** | 3.211*** | 2.535** | 2.059** |
| 1 | 4.339*** | 3.884*** | 3.342*** | 2.884*** | 2.297** | 1.780* |
| 2 | 3.427*** | 3.024*** | 2.465** | 2.176** | 1.782* | 1.813* |
| 3 | 2.444** | 2.263** | 1.838* | 1.943* | 1.415 | 0.760 |
| 4 | 1.720 | 1.413 | 1.098 | 1.052 | 1.067 | 0.267 |
| 5 | 1.042 | 1.226 | 0.909 | 0.739 | 0.426 | 0.136 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.356*** | 5.371*** | 4.510*** | 4.214*** | 3.740*** | 3.447*** |
| 1 | 3.901*** | 3.820*** | 3.548*** | 2.971*** | 3.100*** | 2.437** |
| 2 | 2.958*** | 2.834** | 2.674** | 2.459** | 2.390** | 2.239** |
| 3 | 2.046* | 2.098* | 2.016* | 1.732 | 1.898* | 1.692 |
| 4 | 1.677 | 1.543 | 1.717 | 1.556 | 1.282 | 1.303 |
| 5 | 1.137 | 1.038 | 0.980 | 1.012 | 1.100 | 0.698 |

***f = 1***

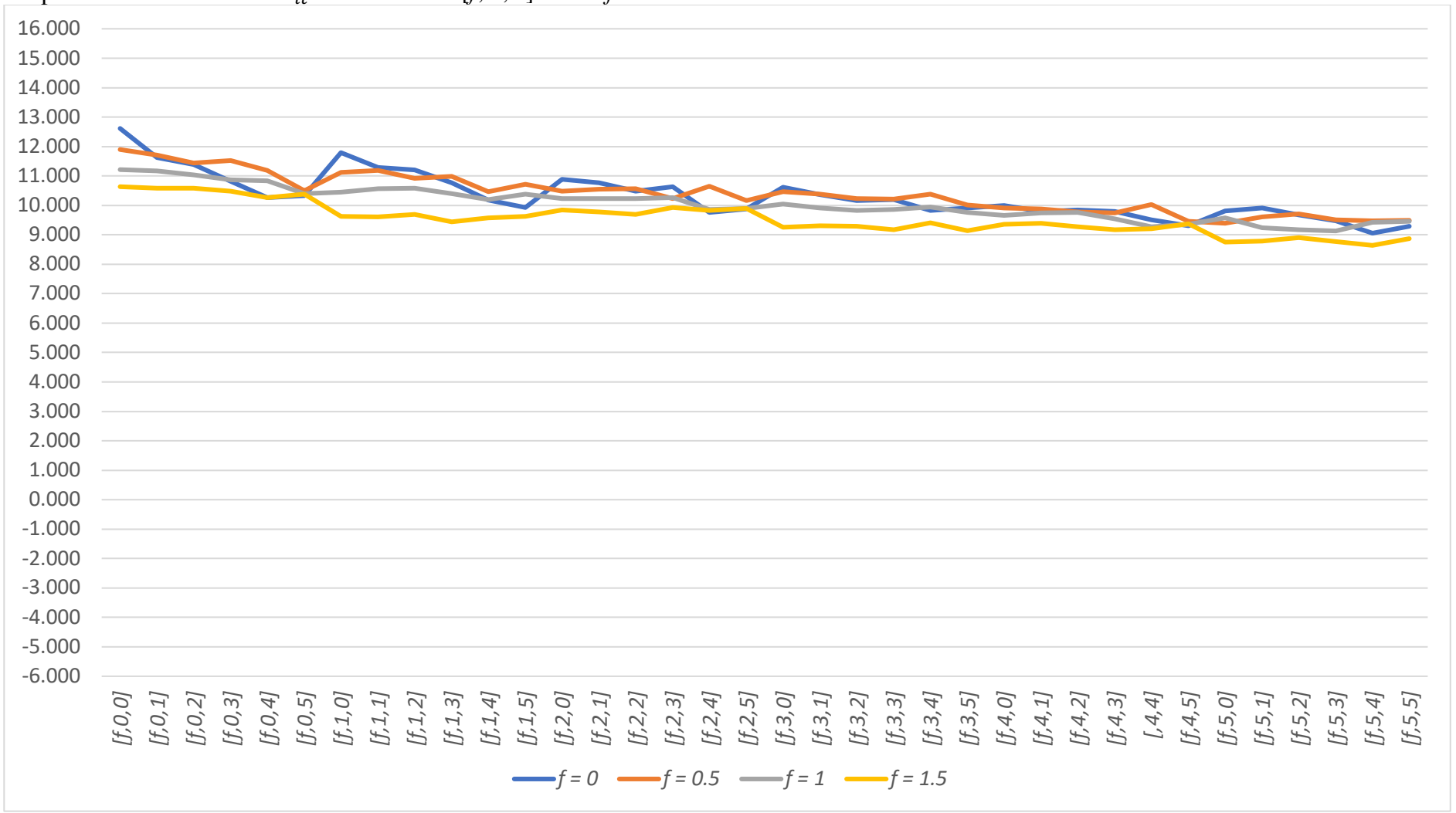
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.185*** | 4.339*** | 3.884*** | 3.342*** | 2.884*** | 2.297** |
| 1 | 3.044*** | 3.026*** | 2.944*** | 2.778** | 2.489** | 2.535** |
| 2 | 2.443** | 2.322** | 2.329** | 2.091* | 2.069* | 1.953* |
| 3 | 1.531 | 1.486 | 1.443 | 1.442 | 1.416 | 0.999 |
| 4 | 1.031 | 0.876 | 1.096 | 0.854 | 0.898 | 0.692 |
| 5 | 0.472 | 0.387 | 0.353 | 0.153 | 0.147 | 0.044 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.188*** | 3.901*** | 3.820*** | 3.548*** | 2.971*** | 3.100*** |
| 1 | 2.094* | 2.092* | 2.067* | 1.997* | 1.862* | 1.579 |
| 2 | 0.845 | 0.823 | 0.768 | 0.622 | 0.720 | 0.740 |
| 3 | 0.261 | 0.239 | 0.283 | 0.293 | 0.199 | 0.046 |
| 4 | 0.005 | 0.023 | 0.078 | -0.003 | -0.239 | -0.124 |
| 5 | 0.063 | 0.154 | -0.086 | -0.041 | 0.077 | 0.106 |

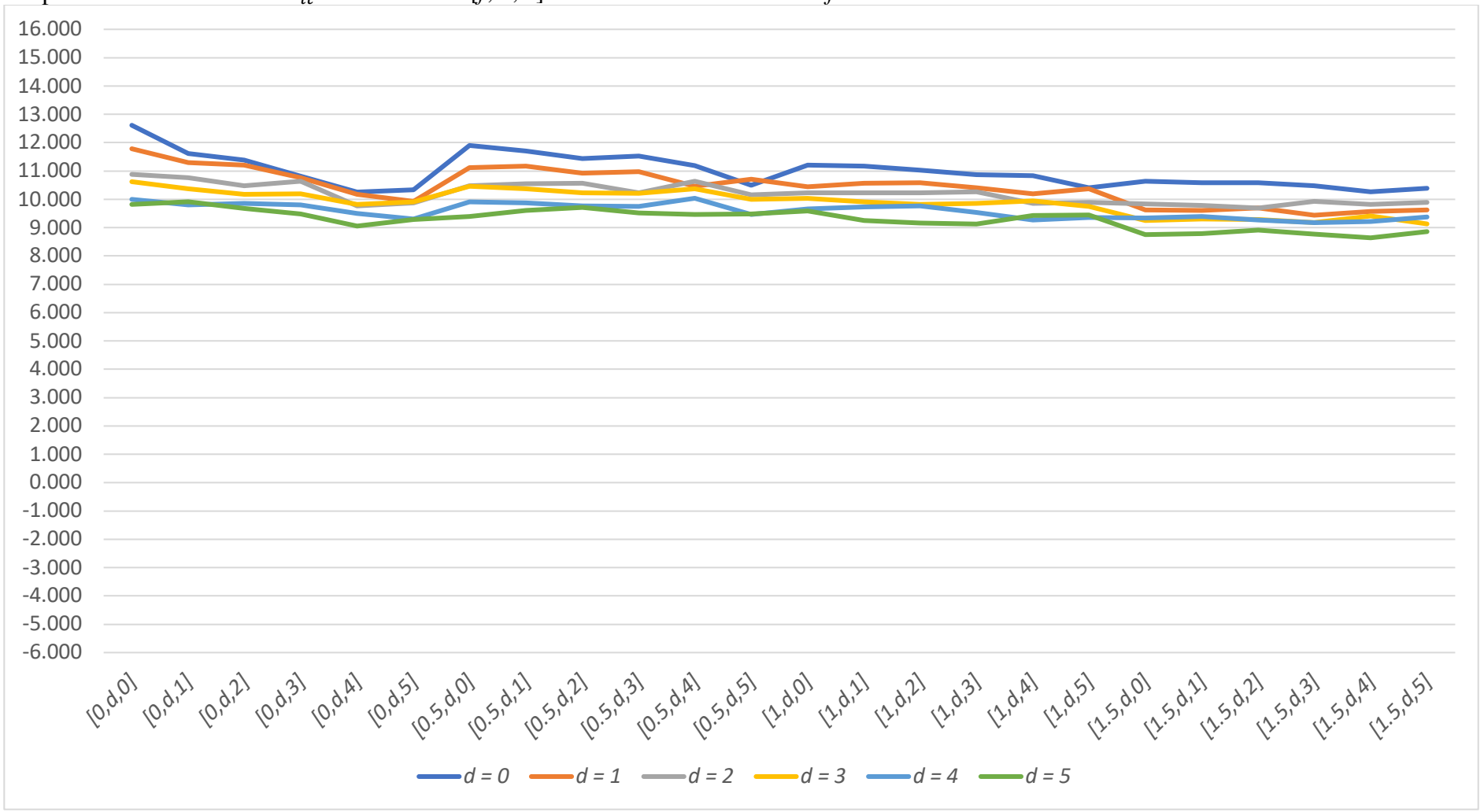
**Appendix 153: VW Europe S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



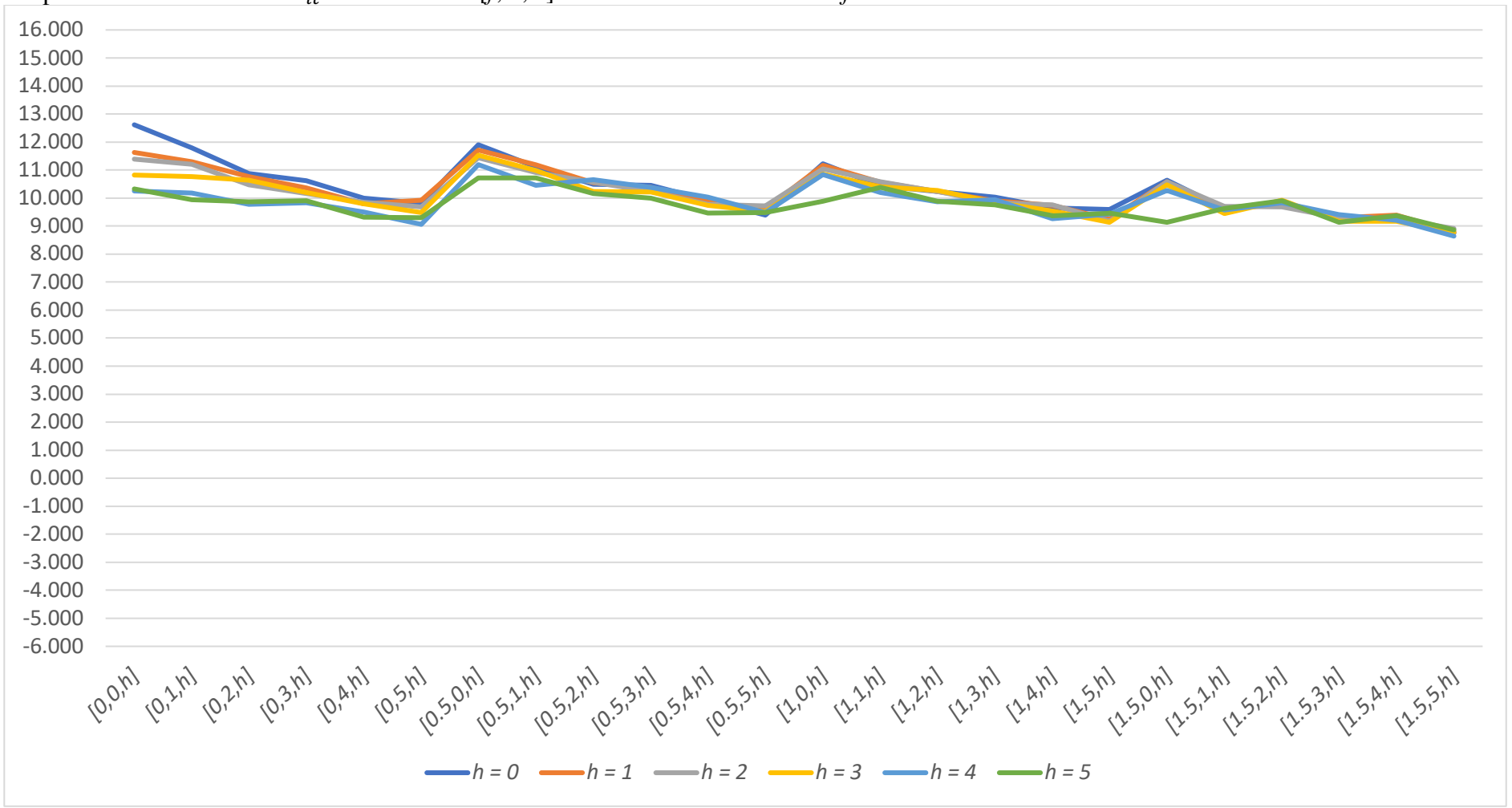
**Appendix 154: VW Europe S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 155: VW Europe S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 156: VW Europe S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.614*** | 11.623*** | 11.386*** | 10.812*** | 10.256*** | 10.330*** |
| 1 | 11.785*** | 11.294*** | 11.203*** | 10.766*** | 10.174*** | 9.934*** |
| 2 | 10.881*** | 10.762*** | 10.477*** | 10.641*** | 9.768*** | 9.870*** |
| 3 | 10.622*** | 10.365*** | 10.169*** | 10.196*** | 9.823*** | 9.911*** |
| 4 | 9.993*** | 9.802*** | 9.849*** | 9.802*** | 9.507*** | 9.312*** |
| 5 | 9.816*** | 9.914*** | 9.682*** | 9.480*** | 9.055*** | 9.294*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.897*** | 11.712*** | 11.436*** | 11.528*** | 11.192*** | 10.500*** |
| 1 | 11.117*** | 11.180*** | 10.915*** | 10.979*** | 10.462*** | 10.718*** |
| 2 | 10.486*** | 10.552*** | 10.565*** | 10.237*** | 10.646*** | 10.155*** |
| 3 | 10.461*** | 10.380*** | 10.230*** | 10.217*** | 10.380*** | 10.004*** |
| 4 | 9.918*** | 9.870*** | 9.771*** | 9.741*** | 10.037*** | 9.464*** |
| 5 | 9.392*** | 9.607*** | 9.717*** | 9.513*** | 9.473*** | 9.489*** |

***f = 1***

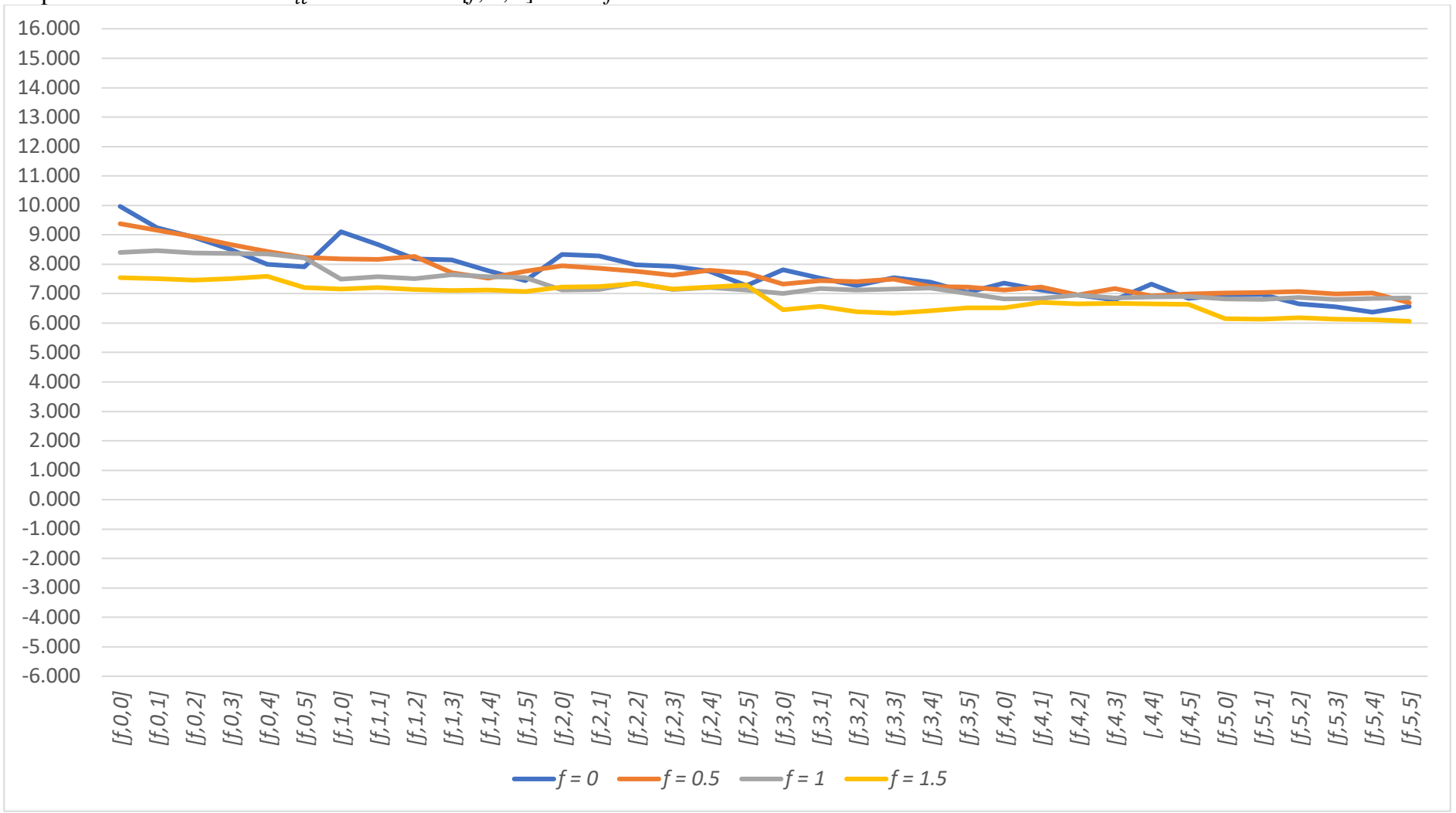
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.215*** | 11.785*** | 11.294*** | 11.203*** | 10.766*** | 10.174*** |
| 1 | 10.444*** | 10.560*** | 10.583*** | 10.406*** | 10.192*** | 10.380*** |
| 2 | 10.227*** | 10.237*** | 10.234*** | 10.271*** | 9.858*** | 9.889*** |
| 3 | 10.038*** | 9.910*** | 9.822*** | 9.855*** | 9.942*** | 9.755*** |
| 4 | 9.655*** | 9.739*** | 9.762*** | 9.536*** | 9.269*** | 9.365*** |
| 5 | 9.583*** | 9.248*** | 9.167*** | 9.131*** | 9.432*** | 9.456*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.635*** | 11.117*** | 11.180*** | 10.915*** | 10.979*** | 10.462*** |
| 1 | 9.628*** | 9.612*** | 9.696*** | 9.439*** | 9.568*** | 9.631*** |
| 2 | 9.845*** | 9.777*** | 9.692*** | 9.922*** | 9.825*** | 9.895*** |
| 3 | 9.255*** | 9.301*** | 9.291*** | 9.173*** | 9.404*** | 9.132*** |
| 4 | 9.349*** | 9.390*** | 9.270*** | 9.176*** | 9.211*** | 9.376*** |
| 5 | 8.753*** | 8.794*** | 8.911*** | 8.770*** | 8.641*** | 8.862*** |

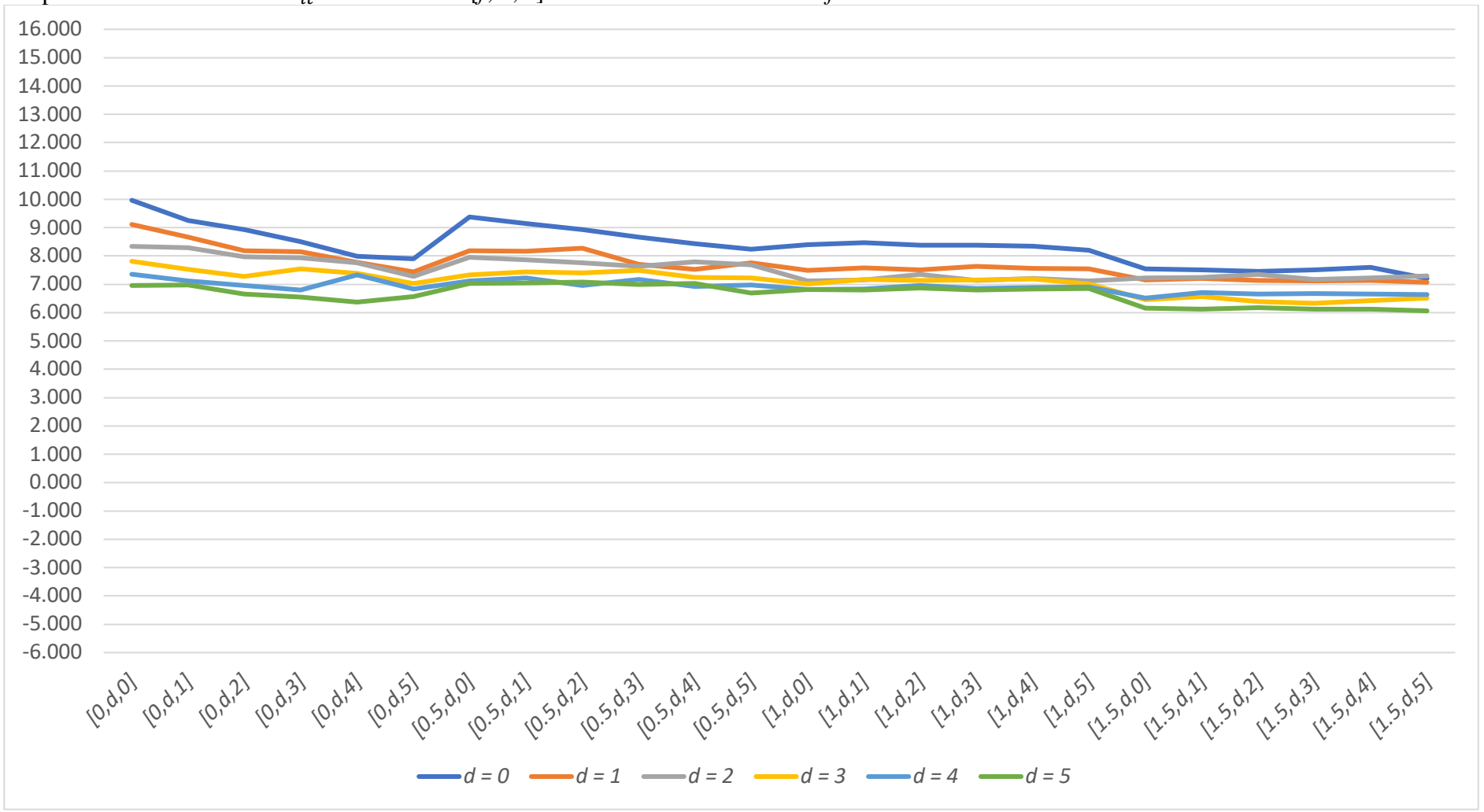
**Appendix 157: VW Europe S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



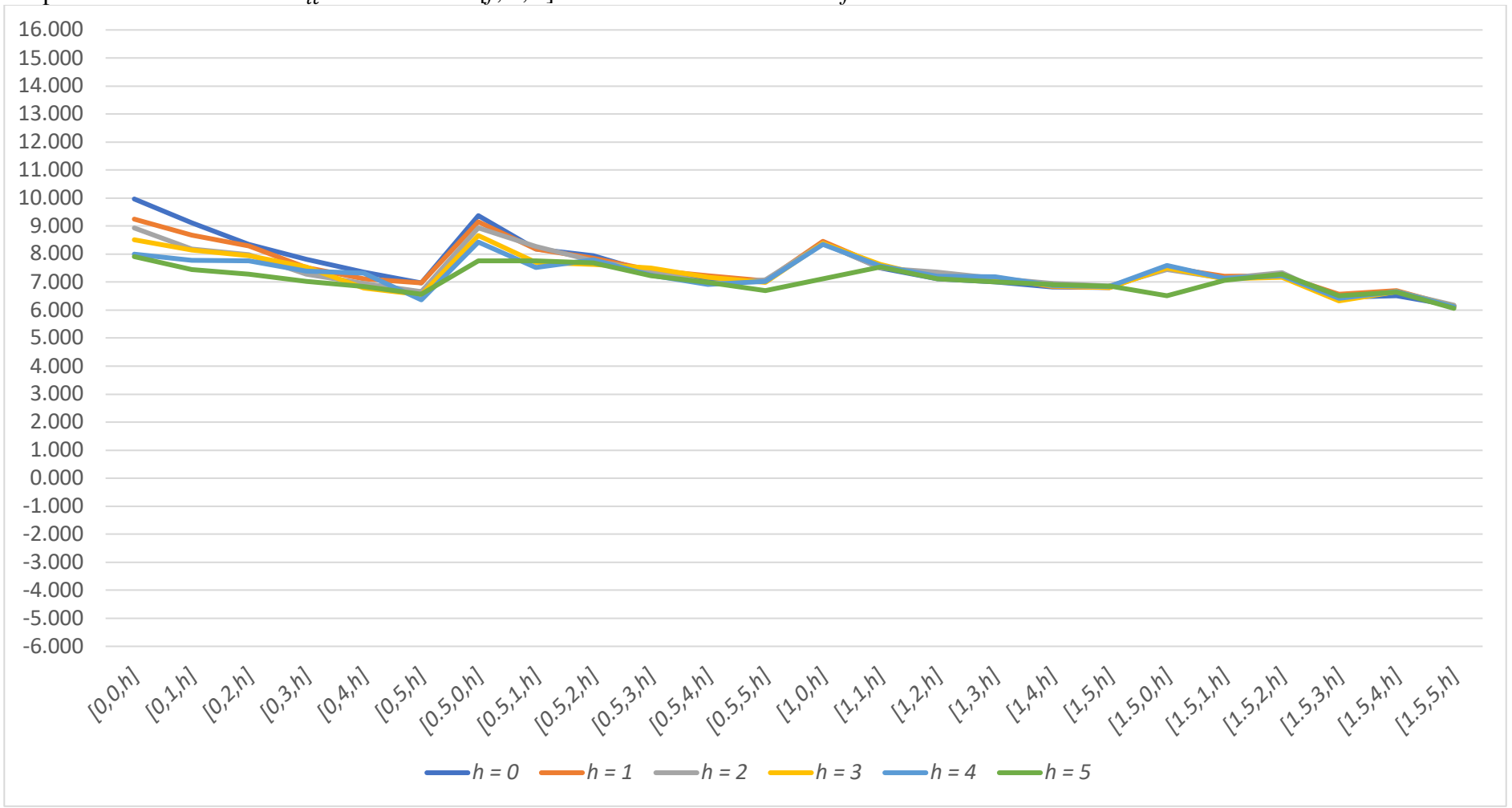
**Appendix 158: VW Europe S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 159: VW Europe S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 160: VW Europe S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.966*** | 9.247*** | 8.928*** | 8.504*** | 7.996*** | 7.909*** |
| 1 | 9.112*** | 8.670*** | 8.186*** | 8.143*** | 7.779*** | 7.440*** |
| 2 | 8.339*** | 8.285*** | 7.973*** | 7.937*** | 7.761*** | 7.277*** |
| 3 | 7.812*** | 7.520*** | 7.274*** | 7.536*** | 7.389*** | 7.033*** |
| 4 | 7.355*** | 7.119*** | 6.957*** | 6.795*** | 7.326*** | 6.834*** |
| 5 | 6.962*** | 6.976*** | 6.656*** | 6.552*** | 6.371*** | 6.572*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.376*** | 9.152*** | 8.936*** | 8.661*** | 8.428*** | 8.235*** |
| 1 | 8.181*** | 8.172*** | 8.265*** | 7.711*** | 7.527*** | 7.757*** |
| 2 | 7.950*** | 7.857*** | 7.764*** | 7.633*** | 7.796*** | 7.693*** |
| 3 | 7.332*** | 7.435*** | 7.405*** | 7.499*** | 7.237*** | 7.222*** |
| 4 | 7.116*** | 7.223*** | 6.960*** | 7.172*** | 6.919*** | 6.982*** |
| 5 | 7.023*** | 7.042*** | 7.078*** | 6.987*** | 7.029*** | 6.692*** |

***f = 1***

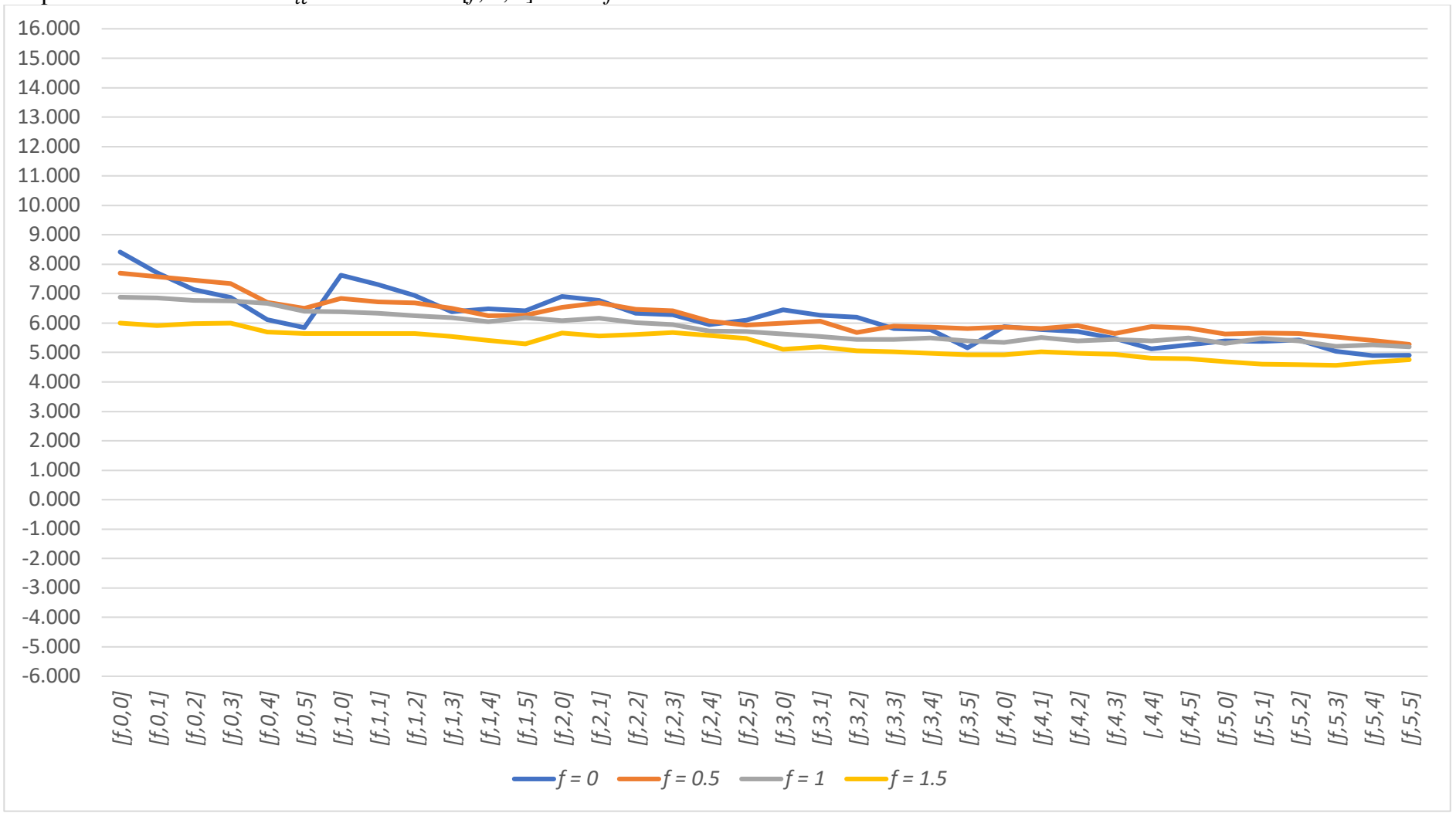
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.406*** | 9.112*** | 8.670*** | 8.186*** | 8.143*** | 7.779*** |
| 1 | 7.498*** | 7.575*** | 7.506*** | 7.639*** | 7.570*** | 7.539*** |
| 2 | 7.118*** | 7.148*** | 7.351*** | 7.136*** | 7.215*** | 7.118*** |
| 3 | 7.006*** | 7.169*** | 7.128*** | 7.162*** | 7.198*** | 7.012*** |
| 4 | 6.819*** | 6.834*** | 6.958*** | 6.853*** | 6.882*** | 6.907*** |
| 5 | 6.814*** | 6.806*** | 6.867*** | 6.804*** | 6.842*** | 6.855*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.548*** | 8.181*** | 8.172*** | 8.265*** | 7.711*** | 7.527*** |
| 1 | 7.159*** | 7.212*** | 7.137*** | 7.110*** | 7.128*** | 7.071*** |
| 2 | 7.222*** | 7.234*** | 7.341*** | 7.163*** | 7.221*** | 7.291*** |
| 3 | 6.460*** | 6.566*** | 6.390*** | 6.330*** | 6.419*** | 6.515*** |
| 4 | 6.513*** | 6.702*** | 6.653*** | 6.667*** | 6.651*** | 6.632*** |
| 5 | 6.156*** | 6.130*** | 6.177*** | 6.130*** | 6.123*** | 6.063*** |

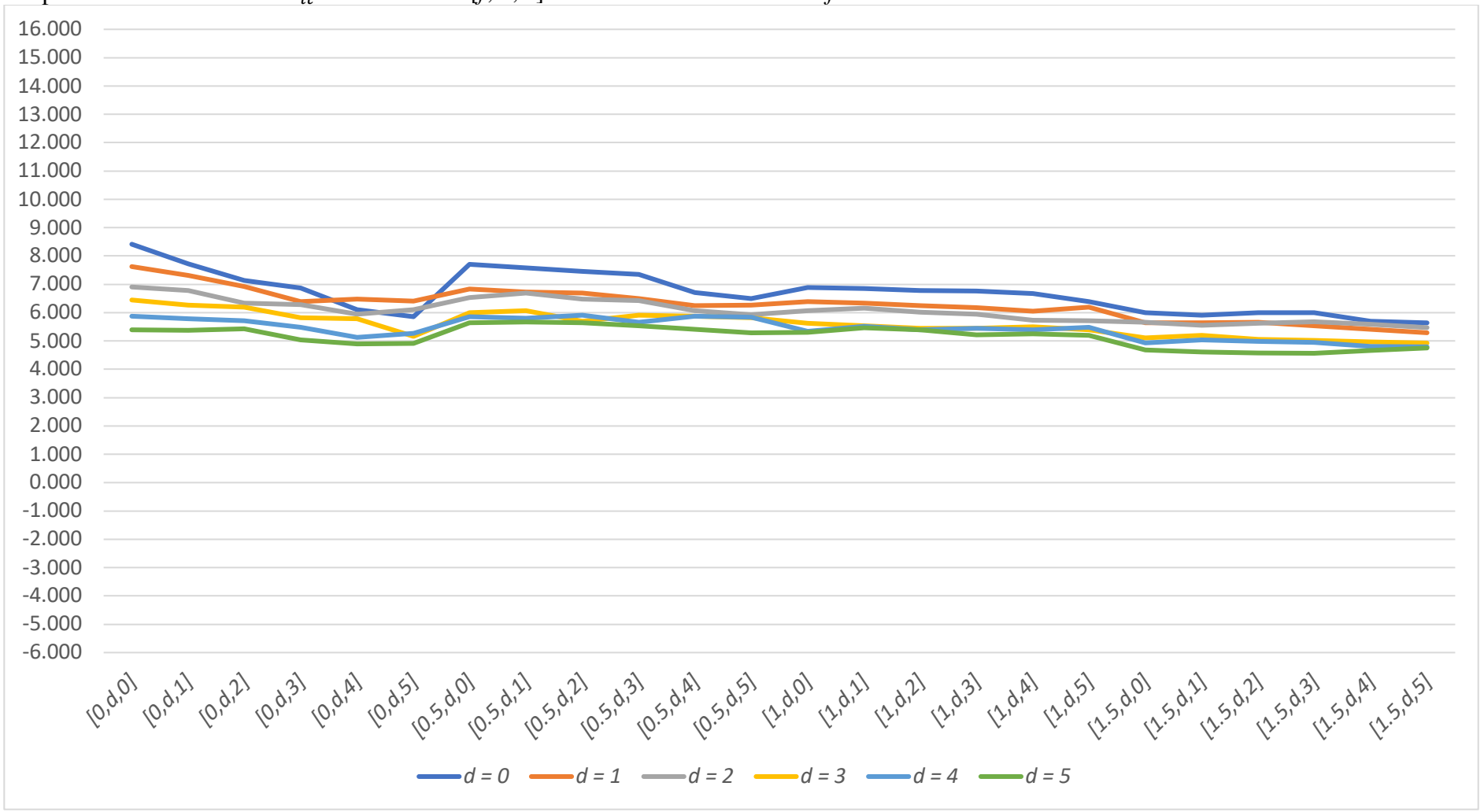
**Appendix 161: VW Europe S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



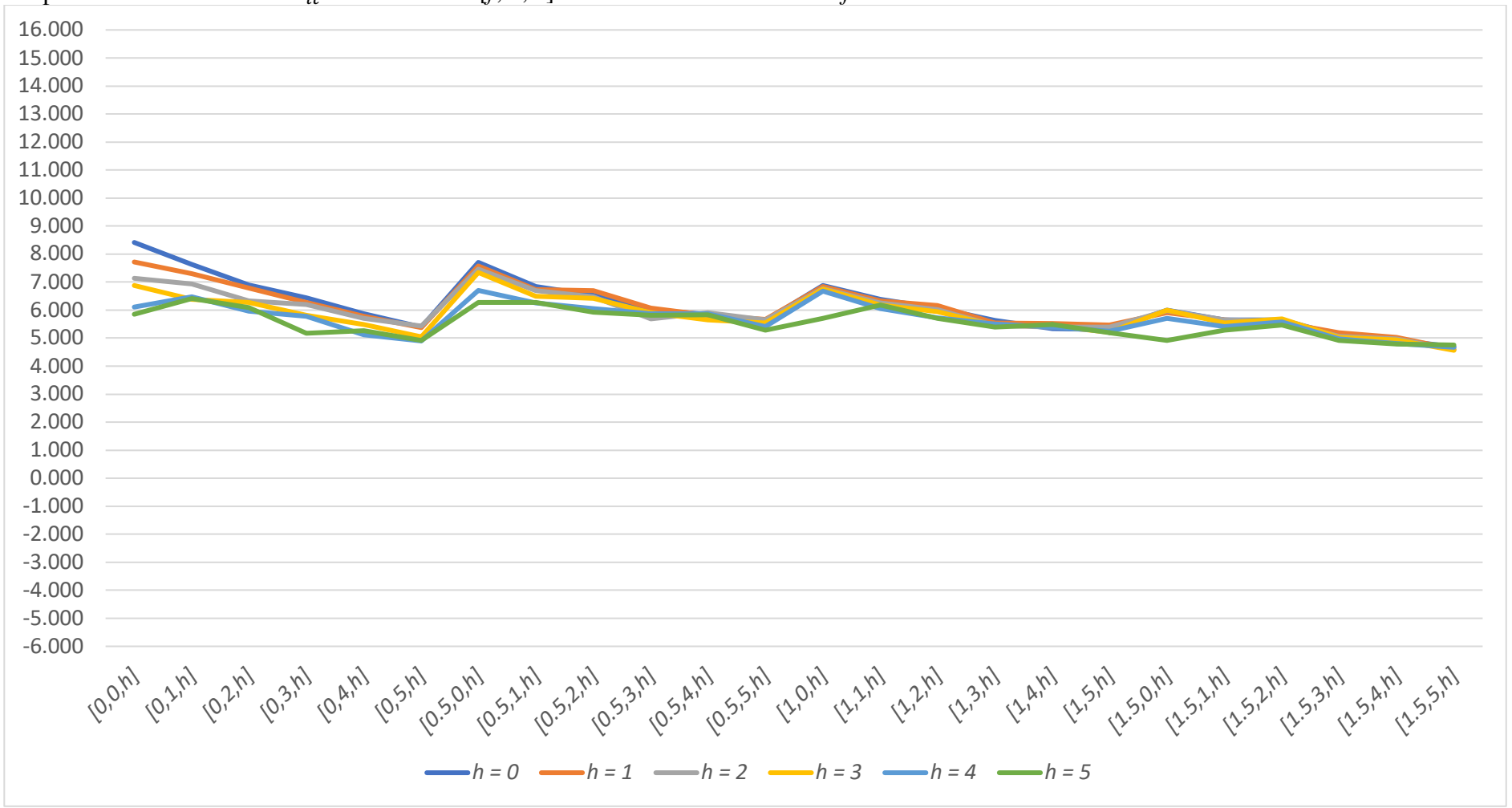
**Appendix 162: VW Europe S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 163: VW Europe S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 164: VW Europe S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.717*** | 7.137*** | 6.876*** | 6.112*** | 5.848*** | 7.625*** |
| 1 | 7.305*** | 6.931*** | 6.392*** | 6.479*** | 6.412*** | 6.905*** |
| 2 | 6.778*** | 6.330*** | 6.278*** | 5.953*** | 6.099*** | 6.446*** |
| 3 | 6.265*** | 6.197*** | 5.817*** | 5.776*** | 5.165*** | 5.874*** |
| 4 | 5.779*** | 5.709*** | 5.483*** | 5.119*** | 5.267*** | 5.399*** |
| 5 | 5.370*** | 5.436*** | 5.046*** | 4.896*** | 4.908*** | 7.697*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.578*** | 7.463*** | 7.342*** | 6.703*** | 6.499*** | 6.841*** |
| 1 | 6.728*** | 6.694*** | 6.497*** | 6.255*** | 6.268*** | 6.530*** |
| 2 | 6.695*** | 6.475*** | 6.417*** | 6.062*** | 5.928*** | 5.998*** |
| 3 | 6.069*** | 5.687*** | 5.901*** | 5.869*** | 5.821*** | 5.859*** |
| 4 | 5.810*** | 5.909*** | 5.654*** | 5.874*** | 5.839*** | 5.634*** |
| 5 | 5.670*** | 5.647*** | 5.533*** | 5.419*** | 5.278*** | 6.880*** |

***f = 1***

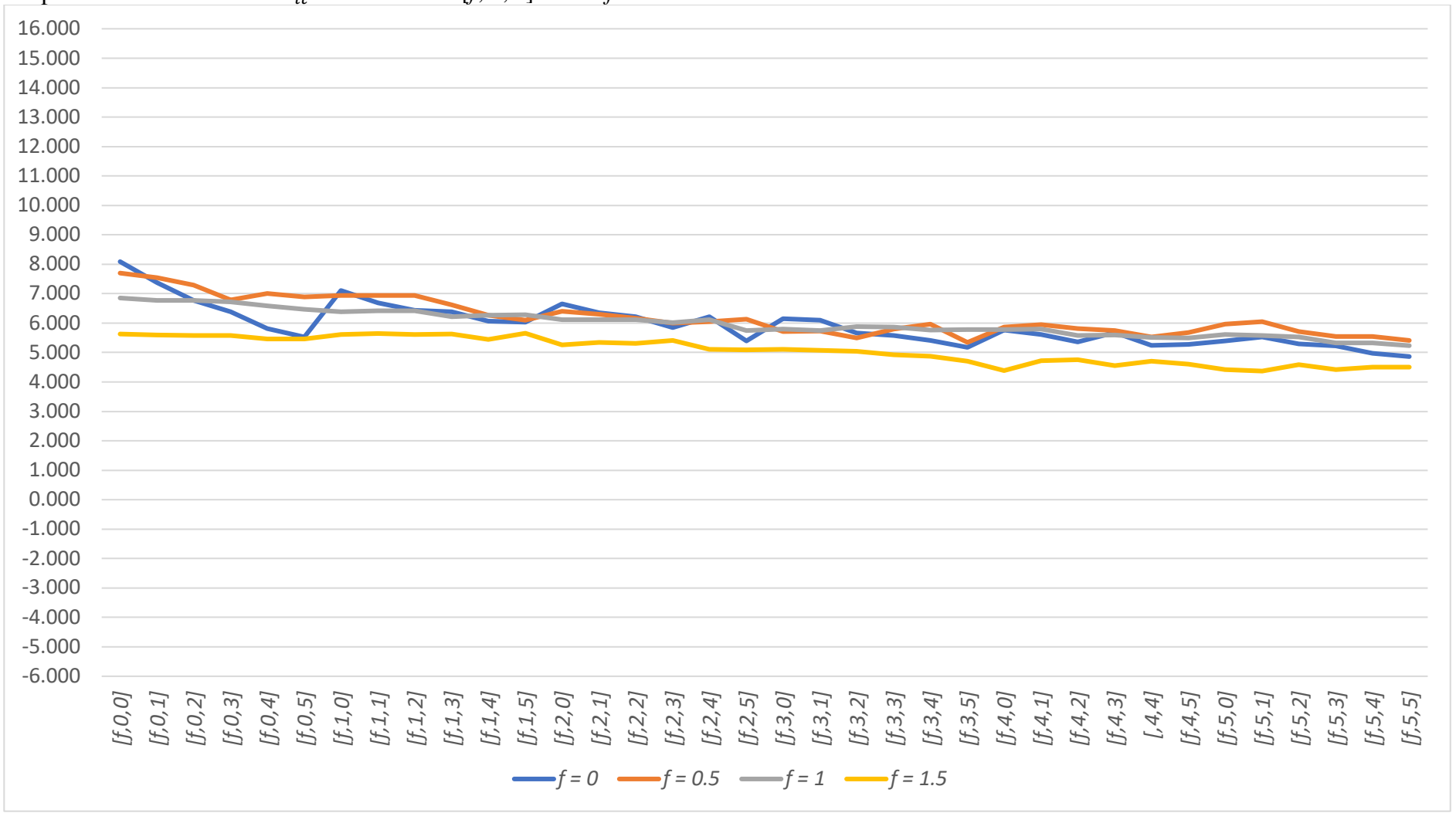
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.848*** | 7.305*** | 6.931*** | 6.392*** | 6.479*** | 6.412*** |
| 1 | 6.333*** | 6.253*** | 6.179*** | 6.050*** | 6.187*** | 6.077*** |
| 2 | 6.163*** | 6.016*** | 5.946*** | 5.731*** | 5.712*** | 5.626*** |
| 3 | 5.544*** | 5.442*** | 5.446*** | 5.500*** | 5.388*** | 5.346*** |
| 4 | 5.515*** | 5.387*** | 5.438*** | 5.386*** | 5.488*** | 5.308*** |
| 5 | 5.471*** | 5.395*** | 5.211*** | 5.254*** | 5.193*** | 6.001*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.916*** | 6.728*** | 6.694*** | 6.497*** | 6.255*** | 6.268*** |
| 1 | 5.645*** | 5.654*** | 5.541*** | 5.409*** | 5.290*** | 5.655*** |
| 2 | 5.556*** | 5.617*** | 5.683*** | 5.585*** | 5.472*** | 5.103*** |
| 3 | 5.196*** | 5.064*** | 5.021*** | 4.971*** | 4.926*** | 4.928*** |
| 4 | 5.029*** | 4.978*** | 4.943*** | 4.801*** | 4.792*** | 4.687*** |
| 5 | 4.604*** | 4.583*** | 4.565*** | 4.673*** | 4.754*** | 8.862*** |

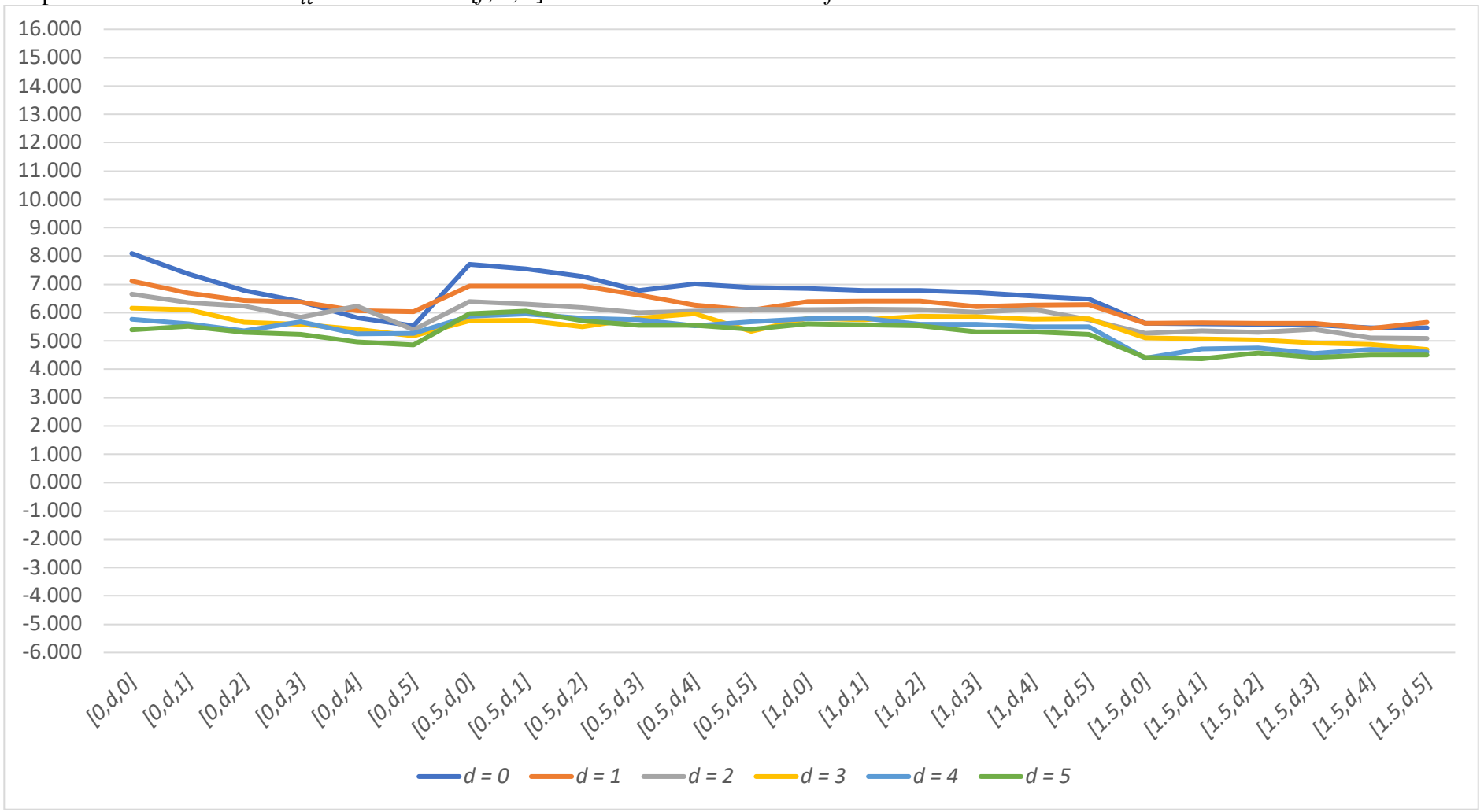
**Appendix 165: VW Europe S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



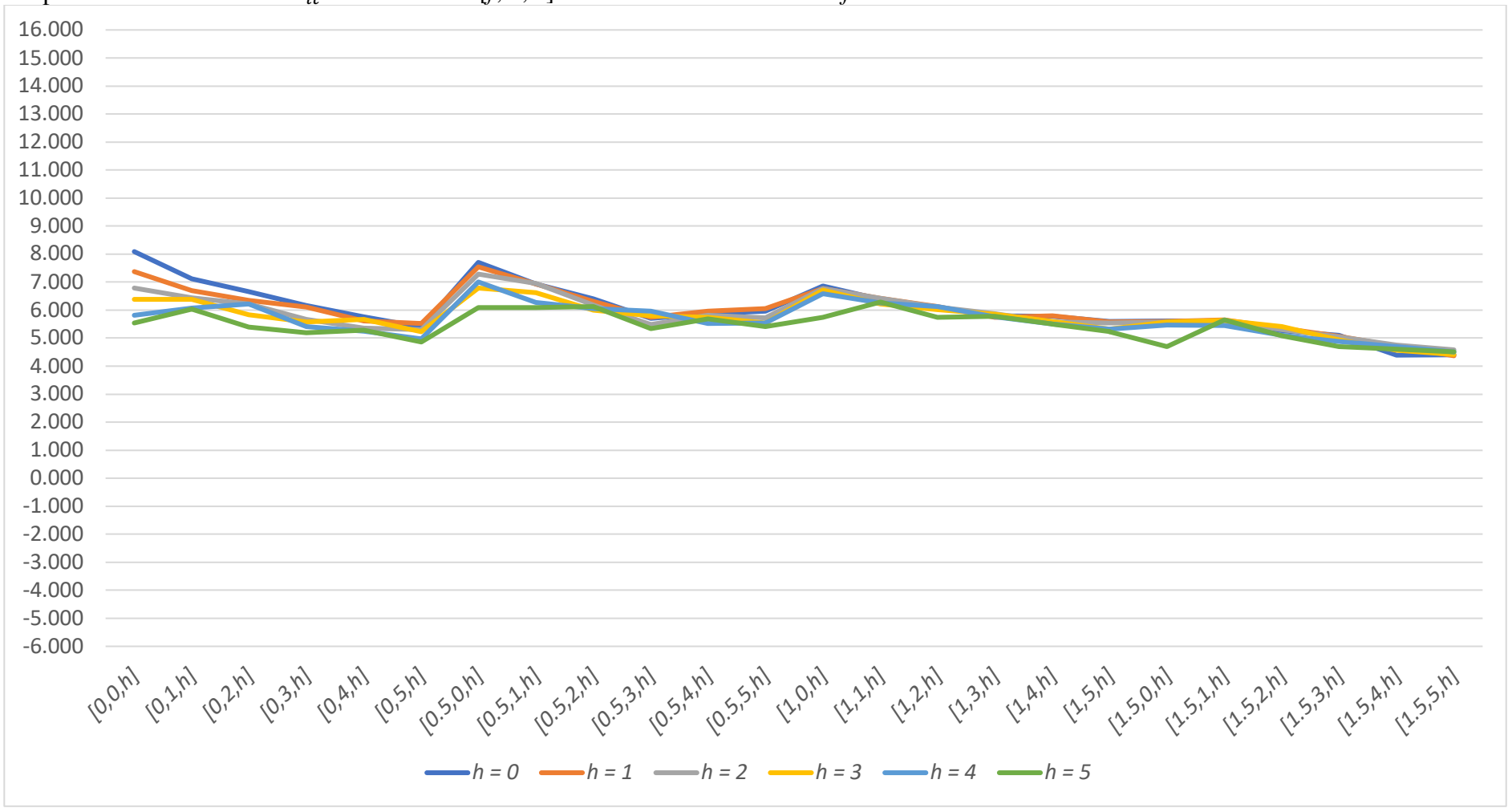
**Appendix 166: VW Europe S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 167: VW Europe S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 168: VW Europe S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.088*** | 7.369*** | 6.778*** | 6.392*** | 5.815*** | 5.534*** |
| 1 | 7.114*** | 6.690*** | 6.431*** | 6.377*** | 6.063*** | 6.030*** |
| 2 | 6.651*** | 6.350*** | 6.221*** | 5.840*** | 6.223*** | 5.399*** |
| 3 | 6.157*** | 6.106*** | 5.666*** | 5.585*** | 5.414*** | 5.183*** |
| 4 | 5.768*** | 5.606*** | 5.364*** | 5.675*** | 5.249*** | 5.277*** |
| 5 | 5.392*** | 5.526*** | 5.300*** | 5.234*** | 4.967*** | 4.863*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.699*** | 7.544*** | 7.285*** | 6.787*** | 7.005*** | 6.883*** |
| 1 | 6.942*** | 6.934*** | 6.943*** | 6.614*** | 6.268*** | 6.095*** |
| 2 | 6.395*** | 6.302*** | 6.173*** | 5.999*** | 6.057*** | 6.126*** |
| 3 | 5.710*** | 5.734*** | 5.494*** | 5.799*** | 5.958*** | 5.344*** |
| 4 | 5.866*** | 5.956*** | 5.810*** | 5.750*** | 5.530*** | 5.682*** |
| 5 | 5.968*** | 6.054*** | 5.719*** | 5.545*** | 5.546*** | 5.417*** |

***f = 1***

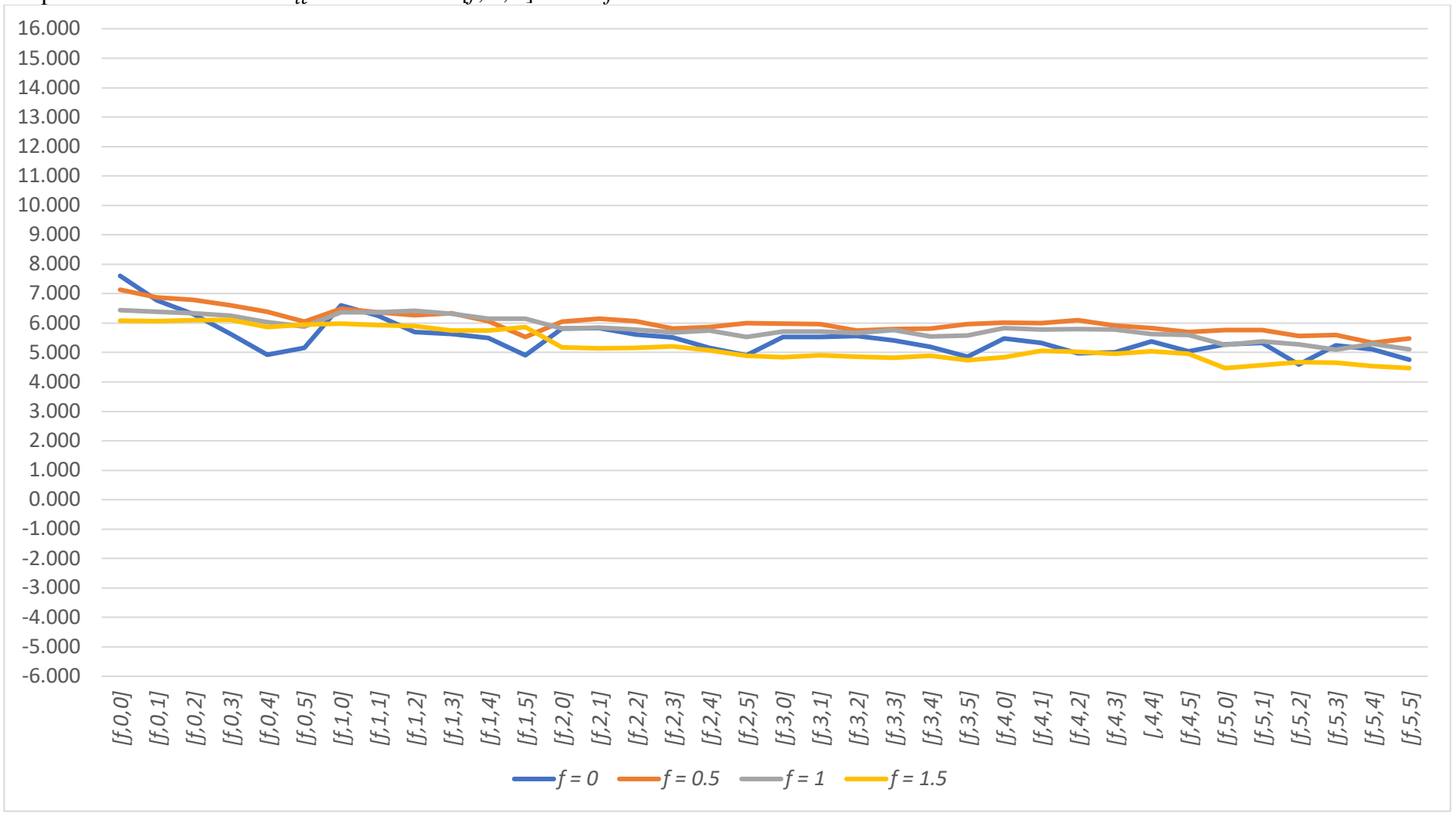
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.853*** | 7.114*** | 6.690*** | 6.431*** | 6.377*** | 6.063*** |
| 1 | 6.385*** | 6.414*** | 6.415*** | 6.220*** | 6.262*** | 6.288*** |
| 2 | 6.110*** | 6.124*** | 6.110*** | 6.023*** | 6.122*** | 5.747*** |
| 3 | 5.796*** | 5.748*** | 5.875*** | 5.859*** | 5.765*** | 5.779*** |
| 4 | 5.782*** | 5.796*** | 5.582*** | 5.591*** | 5.504*** | 5.499*** |
| 5 | 5.604*** | 5.576*** | 5.534*** | 5.323*** | 5.327*** | 5.234*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.622*** | 6.942*** | 6.934*** | 6.943*** | 6.614*** | 6.268*** |
| 1 | 5.619*** | 5.649*** | 5.618*** | 5.632*** | 5.441*** | 5.655*** |
| 2 | 5.261*** | 5.349*** | 5.310*** | 5.410*** | 5.104*** | 5.090*** |
| 3 | 5.102*** | 5.071*** | 5.041*** | 4.927*** | 4.876*** | 4.700*** |
| 4 | 4.392*** | 4.721*** | 4.753*** | 4.562*** | 4.703*** | 4.605*** |
| 5 | 4.412*** | 4.370*** | 4.582*** | 4.415*** | 4.507*** | 4.510*** |

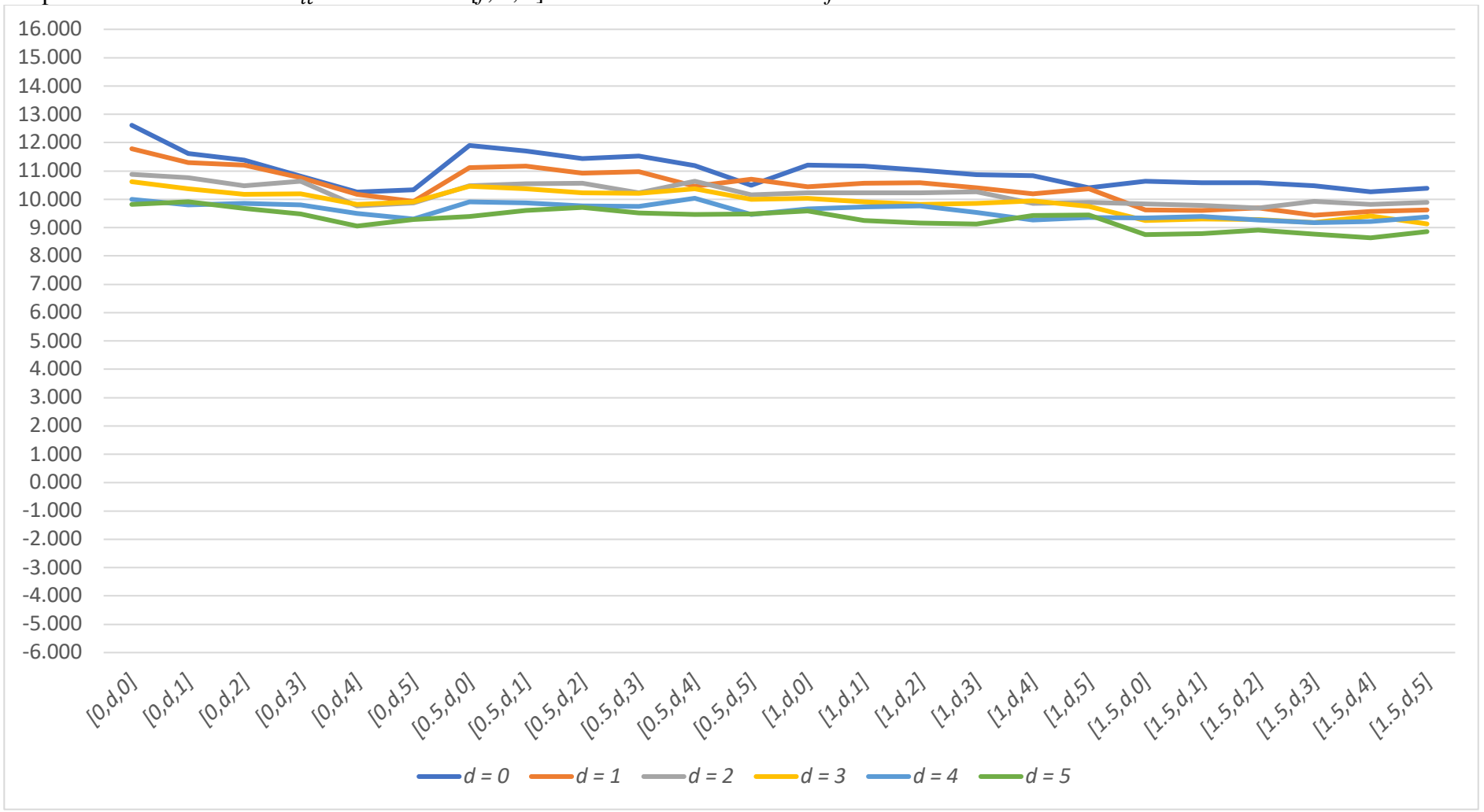
**Appendix 169: VW Europe S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



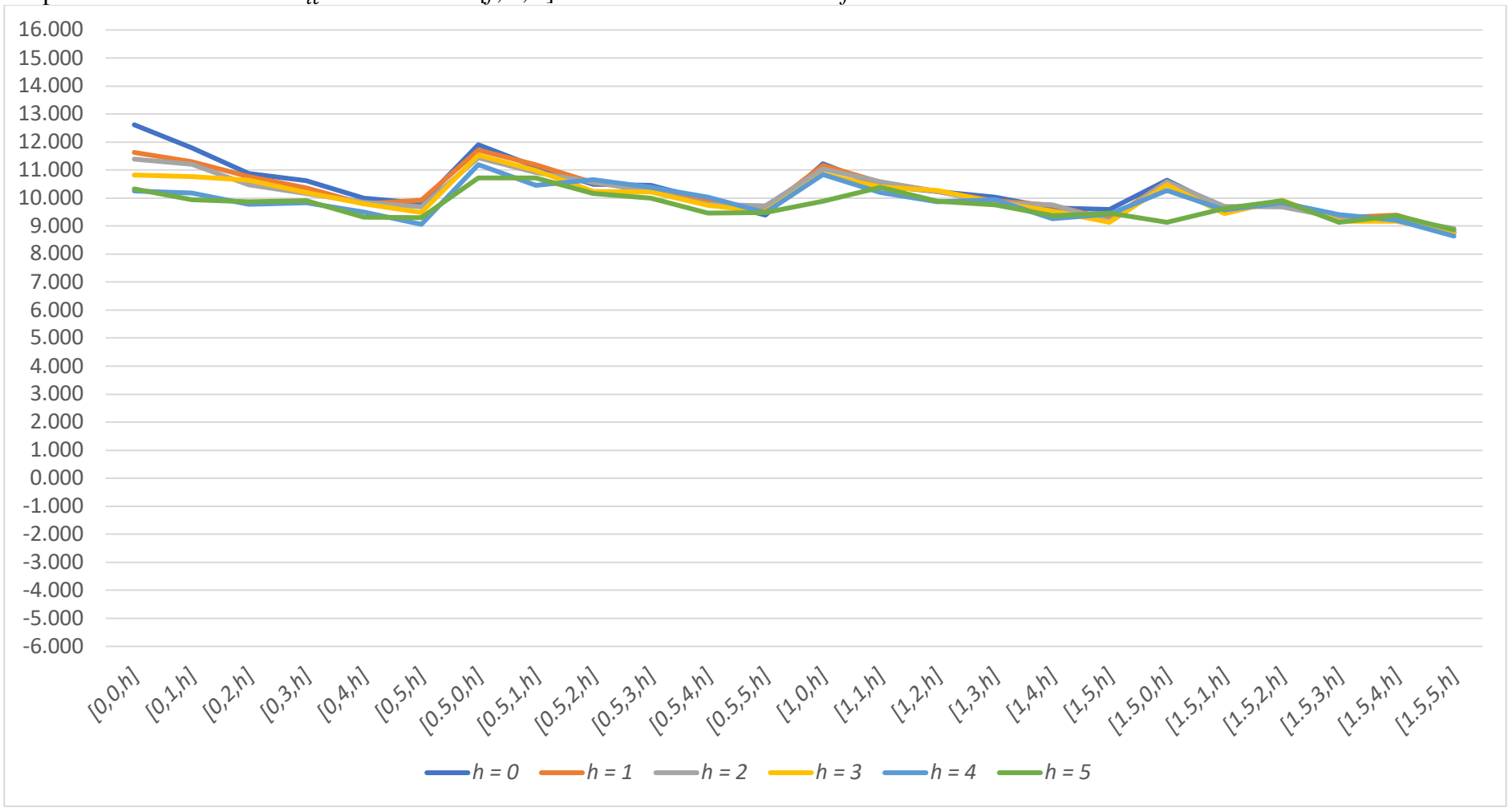
**Appendix 170: VW Europe S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 171: VW Europe S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 172: VW Europe S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.606*** | 6.770*** | 6.302*** | 5.631*** | 4.930*** | 5.167*** |
| 1 | 6.603*** | 6.247*** | 5.704*** | 5.630*** | 5.490*** | 4.906*** |
| 2 | 5.821*** | 5.831*** | 5.606*** | 5.504*** | 5.166*** | 4.902*** |
| 3 | 5.535*** | 5.522*** | 5.564*** | 5.410*** | 5.189*** | 4.862*** |
| 4 | 5.479*** | 5.325*** | 4.977*** | 5.011*** | 5.377*** | 5.039*** |
| 5 | 5.281*** | 5.320*** | 4.593*** | 5.249*** | 5.111*** | 4.756*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.135*** | 6.865*** | 6.795*** | 6.608*** | 6.380*** | 6.056*** |
| 1 | 6.484*** | 6.368*** | 6.275*** | 6.328*** | 6.061*** | 5.528*** |
| 2 | 6.057*** | 6.145*** | 6.066*** | 5.815*** | 5.868*** | 5.994*** |
| 3 | 5.978*** | 5.965*** | 5.749*** | 5.798*** | 5.818*** | 5.964*** |
| 4 | 6.020*** | 5.997*** | 6.102*** | 5.919*** | 5.837*** | 5.698*** |
| 5 | 5.771*** | 5.771*** | 5.567*** | 5.590*** | 5.332*** | 5.481*** |

***f = 1***

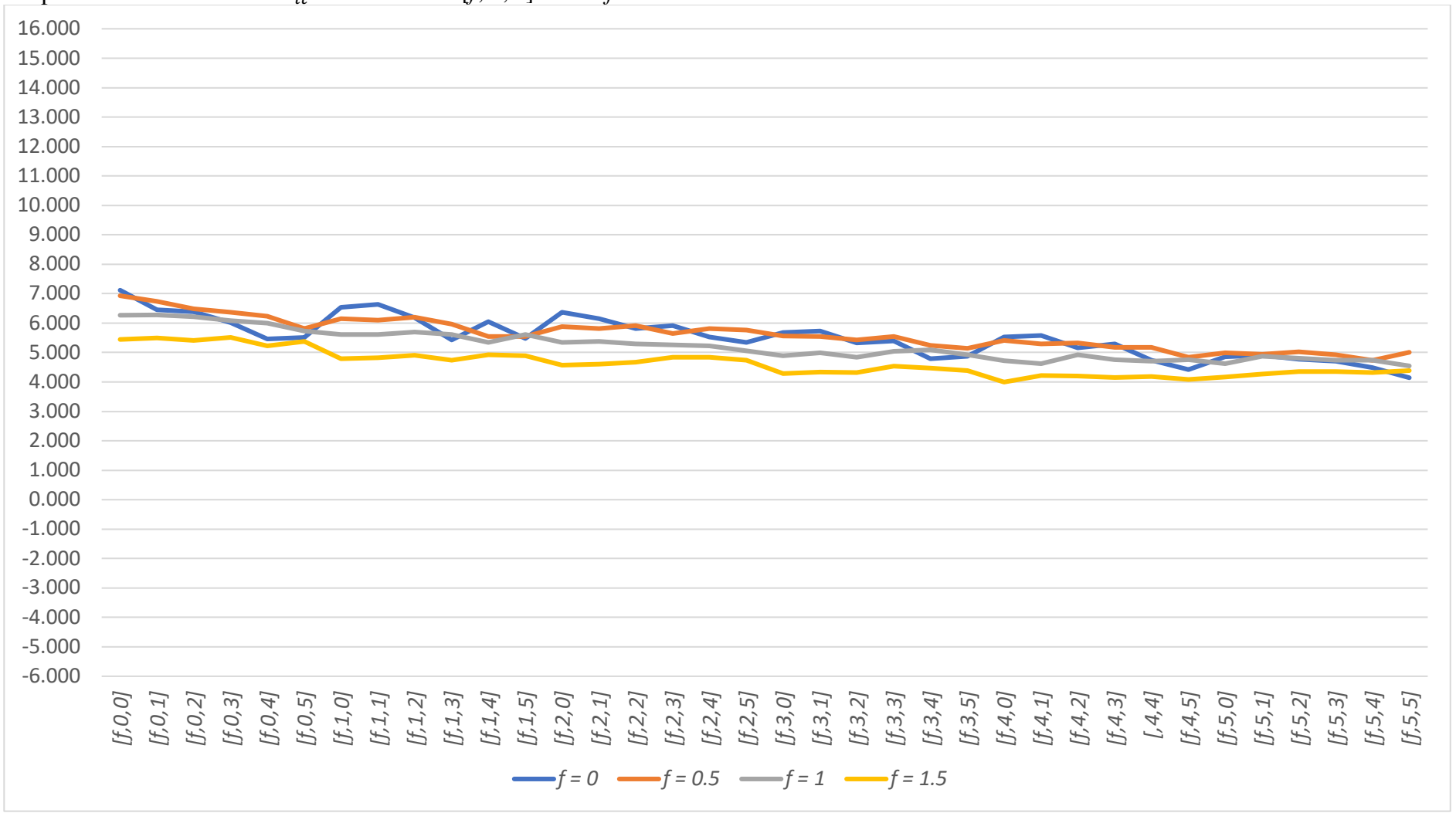
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.440*** | 6.603*** | 6.247*** | 5.704*** | 5.630*** | 5.490*** |
| 1 | 6.376*** | 6.360*** | 6.414*** | 6.313*** | 6.146*** | 6.154*** |
| 2 | 5.816*** | 5.844*** | 5.781*** | 5.678*** | 5.749*** | 5.527*** |
| 3 | 5.705*** | 5.711*** | 5.667*** | 5.769*** | 5.543*** | 5.583*** |
| 4 | 5.832*** | 5.784*** | 5.798*** | 5.781*** | 5.629*** | 5.600*** |
| 5 | 5.259*** | 5.381*** | 5.273*** | 5.096*** | 5.299*** | 5.109*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.079*** | 6.484*** | 6.368*** | 6.275*** | 6.328*** | 6.061*** |
| 1 | 5.974*** | 5.926*** | 5.891*** | 5.739*** | 5.742*** | 5.865*** |
| 2 | 5.179*** | 5.149*** | 5.153*** | 5.210*** | 5.067*** | 4.887*** |
| 3 | 4.832*** | 4.910*** | 4.855*** | 4.826*** | 4.891*** | 4.743*** |
| 4 | 4.846*** | 5.051*** | 5.021*** | 4.965*** | 5.046*** | 4.964*** |
| 5 | 4.474*** | 4.574*** | 4.665*** | 4.657*** | 4.532*** | 4.472*** |

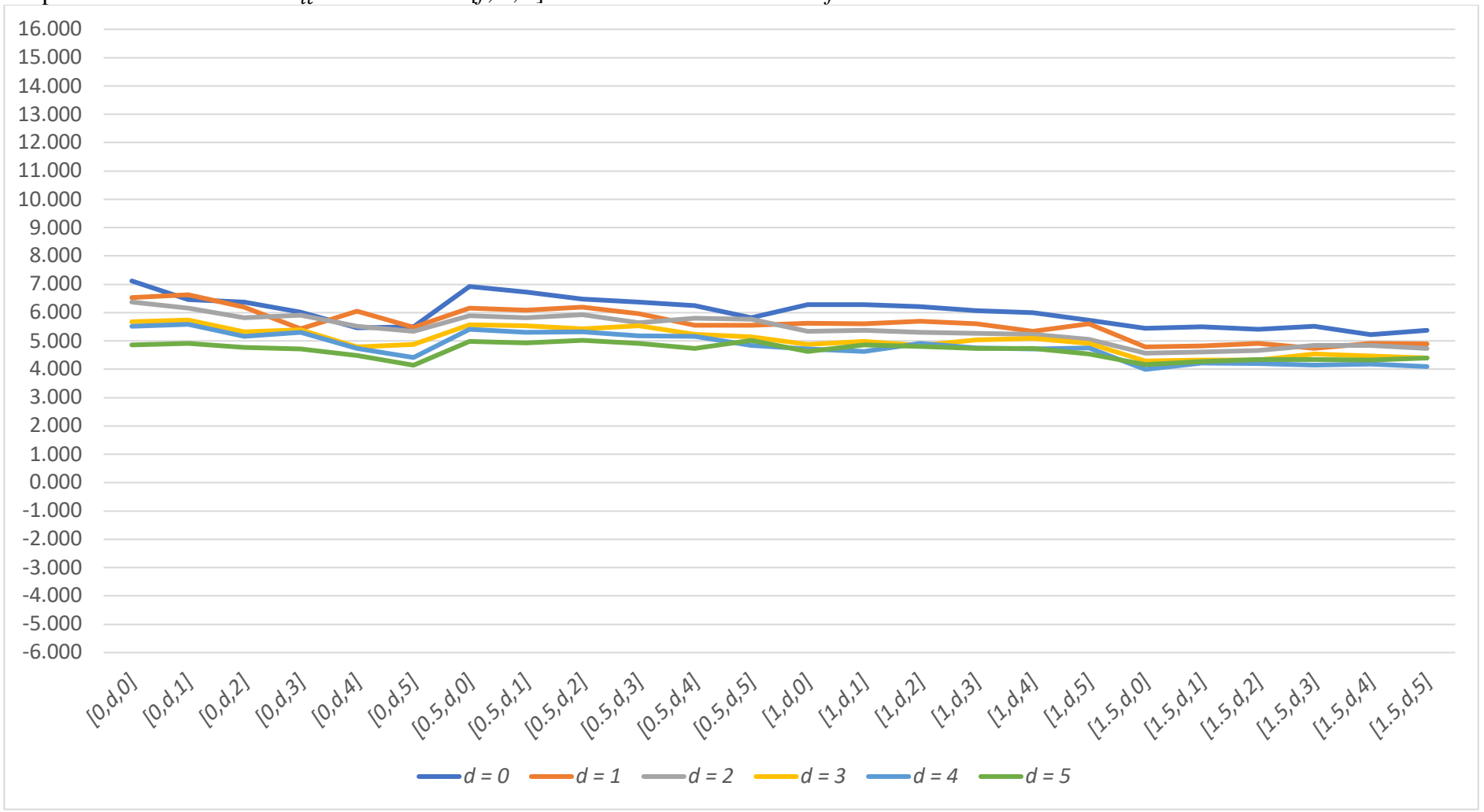
**Appendix 173: EW Europe S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



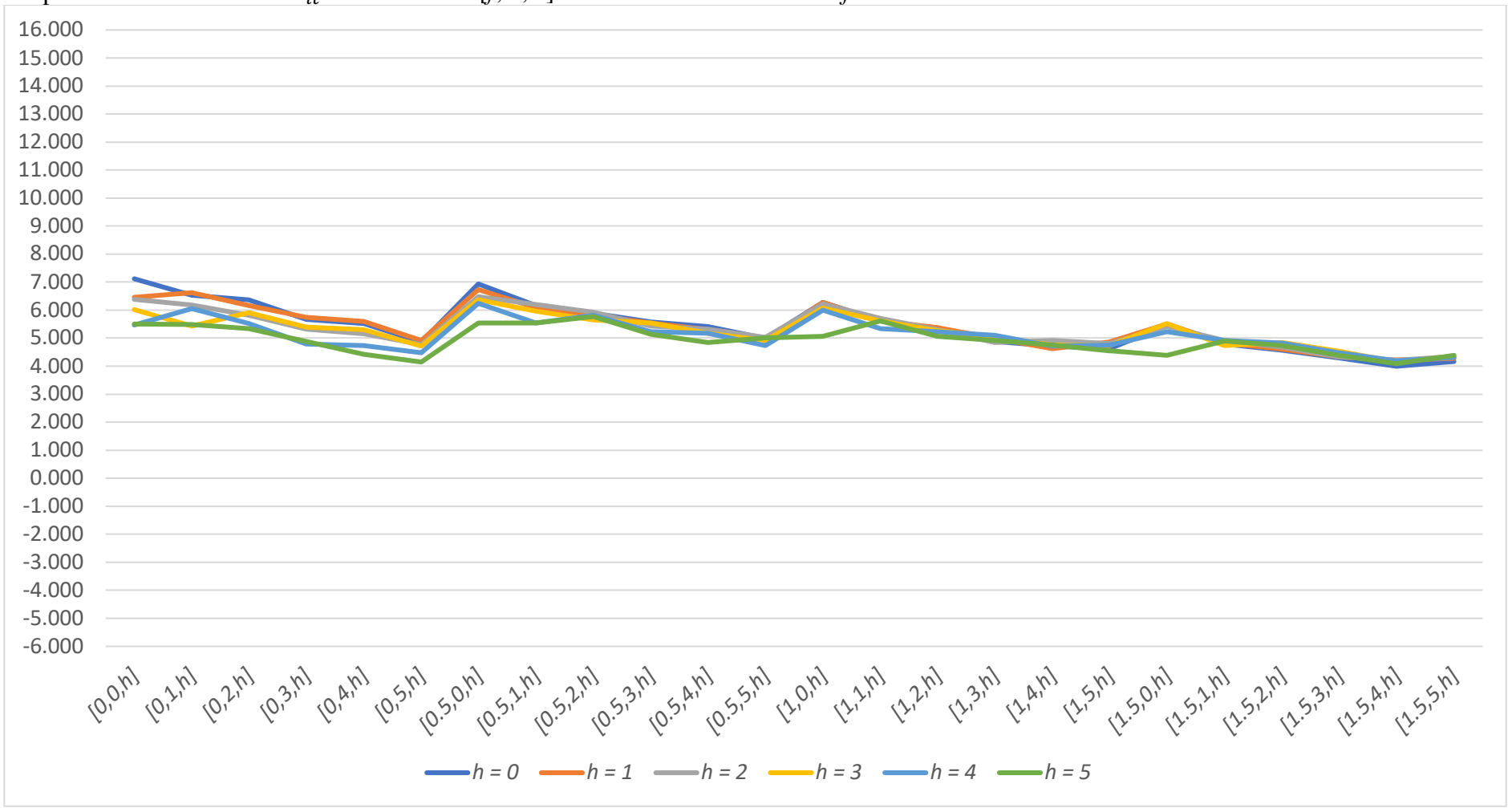
**Appendix 174: EW Europe S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 175: EW Europe S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 176: EW Europe S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.118*** | 6.454*** | 6.377*** | 6.009*** | 5.464*** | 5.505*** |
| 1 | 6.534*** | 6.630*** | 6.185*** | 5.425*** | 6.052*** | 5.481*** |
| 2 | 6.374*** | 6.158*** | 5.822*** | 5.909*** | 5.523*** | 5.342*** |
| 3 | 5.673*** | 5.738*** | 5.320*** | 5.401*** | 4.790*** | 4.881*** |
| 4 | 5.525*** | 5.587*** | 5.157*** | 5.297*** | 4.740*** | 4.415*** |
| 5 | 4.862*** | 4.915*** | 4.767*** | 4.710*** | 4.481*** | 4.144*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.929*** | 6.732*** | 6.478*** | 6.369*** | 6.242*** | 5.812*** |
| 1 | 6.158*** | 6.093*** | 6.201*** | 5.968*** | 5.547*** | 5.549*** |
| 2 | 5.888*** | 5.822*** | 5.923*** | 5.649*** | 5.807*** | 5.770*** |
| 3 | 5.568*** | 5.540*** | 5.427*** | 5.537*** | 5.237*** | 5.142*** |
| 4 | 5.413*** | 5.299*** | 5.321*** | 5.180*** | 5.171*** | 4.843*** |
| 5 | 4.986*** | 4.939*** | 5.022*** | 4.918*** | 4.734*** | 5.014*** |

***f = 1***

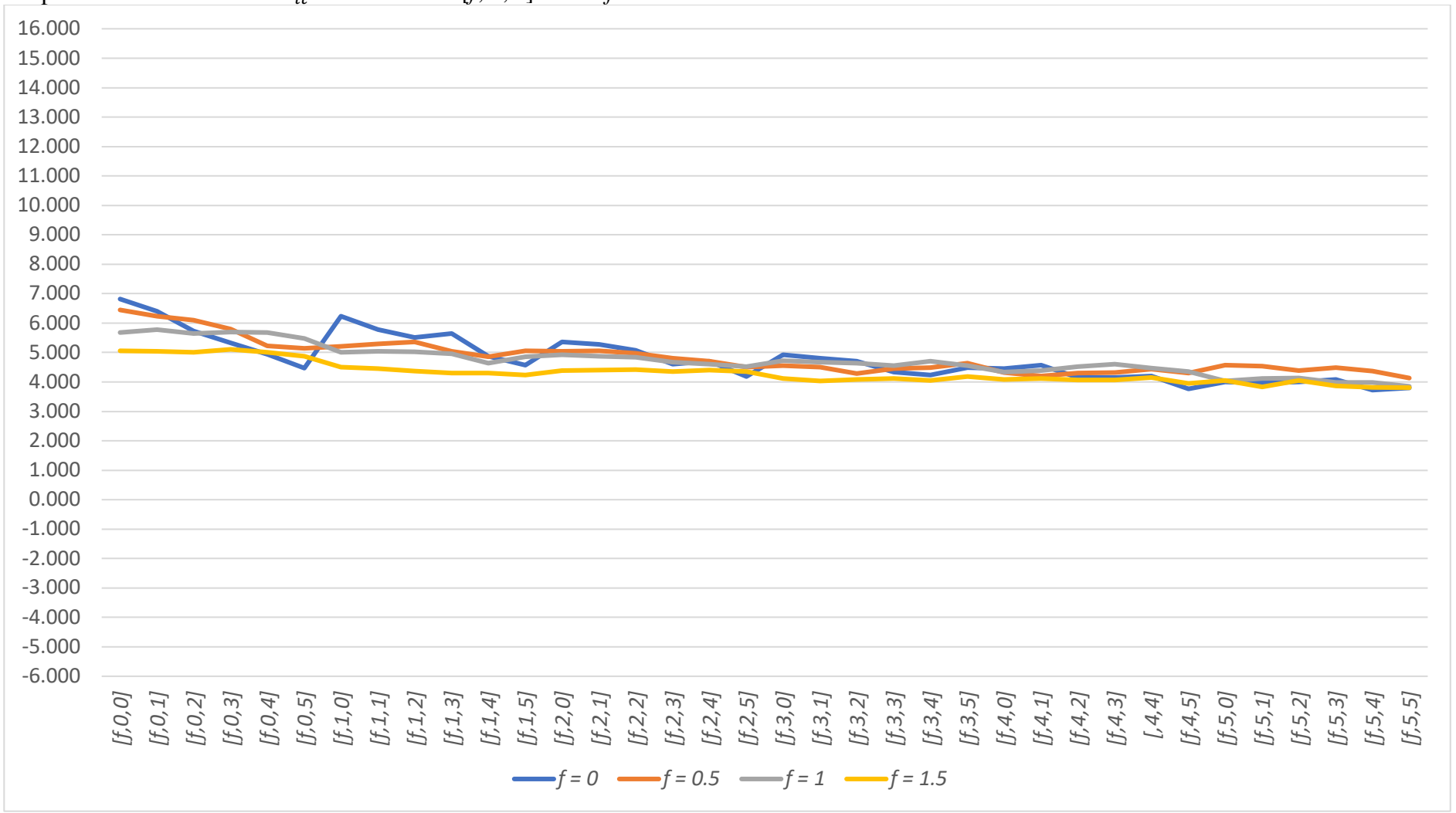
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.275*** | 6.534*** | 6.630*** | 6.185*** | 5.425*** | 6.052*** |
| 1 | 5.617*** | 5.608*** | 5.703*** | 5.606*** | 5.347*** | 5.614*** |
| 2 | 5.338*** | 5.382*** | 5.300*** | 5.263*** | 5.231*** | 5.059*** |
| 3 | 4.885*** | 4.992*** | 4.837*** | 5.040*** | 5.098*** | 4.919*** |
| 4 | 4.715*** | 4.621*** | 4.920*** | 4.758*** | 4.710*** | 4.754*** |
| 5 | 4.622*** | 4.868*** | 4.800*** | 4.737*** | 4.744*** | 4.545*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.442*** | 6.158*** | 6.093*** | 6.201*** | 5.968*** | 5.547*** |
| 1 | 4.784*** | 4.829*** | 4.911*** | 4.740*** | 4.920*** | 4.892*** |
| 2 | 4.569*** | 4.612*** | 4.671*** | 4.835*** | 4.834*** | 4.742*** |
| 3 | 4.293*** | 4.330*** | 4.322*** | 4.537*** | 4.477*** | 4.389*** |
| 4 | 3.996*** | 4.221*** | 4.210*** | 4.148*** | 4.189*** | 4.087*** |
| 5 | 4.160*** | 4.276*** | 4.346*** | 4.349*** | 4.318*** | 4.389*** |

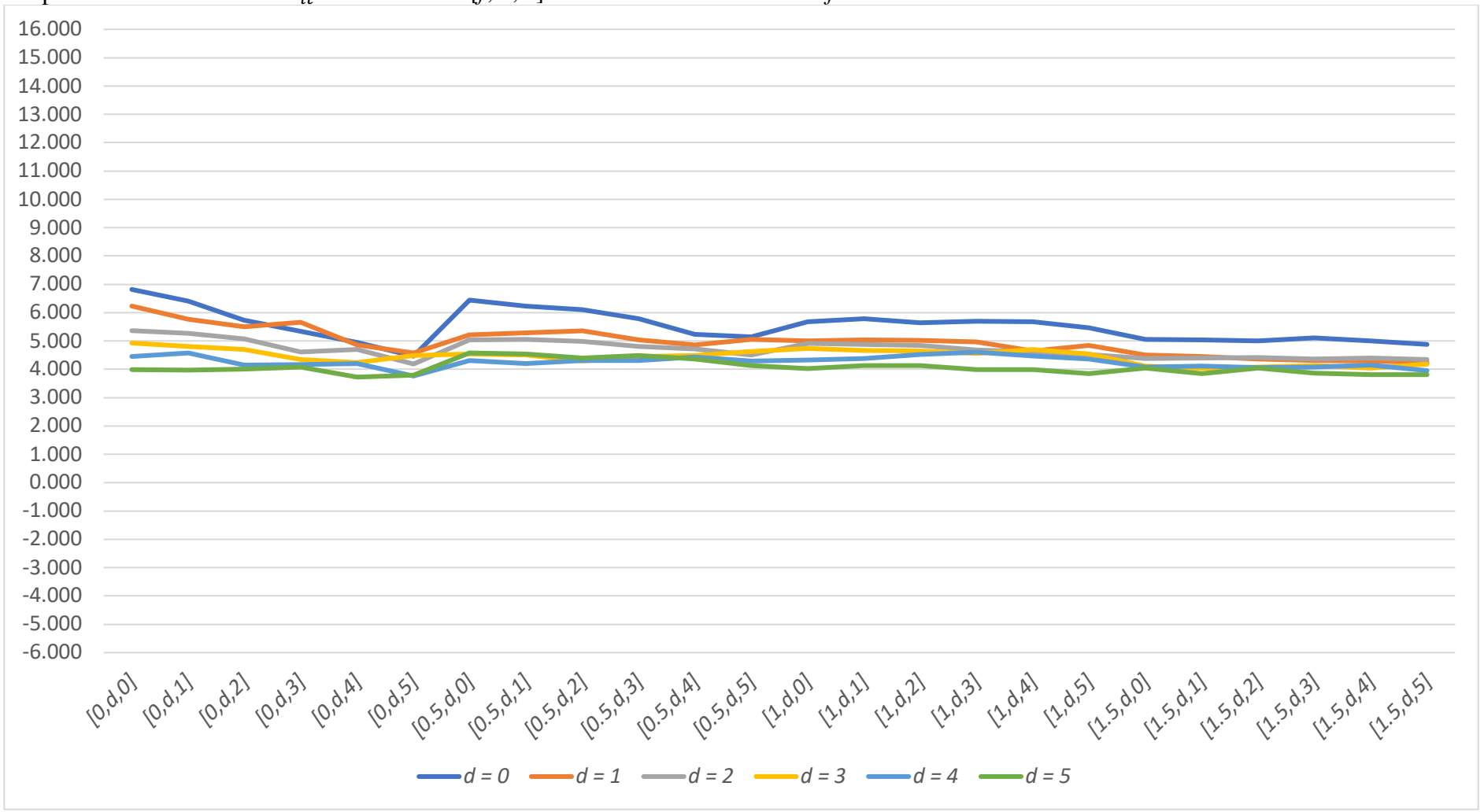
**Appendix 177: EW Europe S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



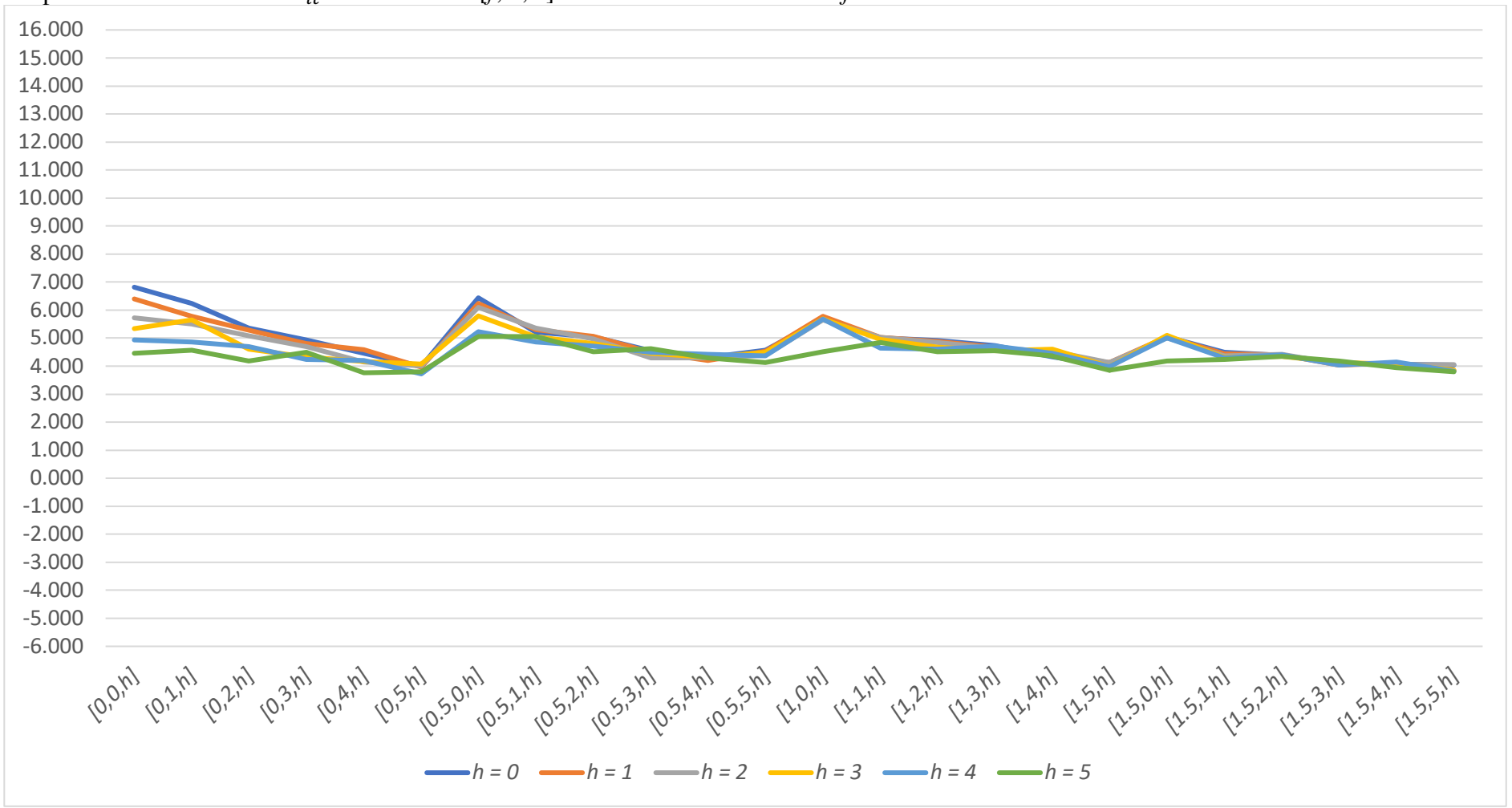
**Appendix 178: EW Europe S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 179: EW Europe S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 180: EW Europe S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.818*** | 6.399*** | 5.730*** | 5.334*** | 4.943*** | 4.463*** |
| 1 | 6.231*** | 5.772*** | 5.505*** | 5.652*** | 4.867*** | 4.568*** |
| 2 | 5.364*** | 5.275*** | 5.077*** | 4.612*** | 4.703*** | 4.186*** |
| 3 | 4.927*** | 4.813*** | 4.706*** | 4.337*** | 4.236*** | 4.489*** |
| 4 | 4.450*** | 4.579*** | 4.149*** | 4.159*** | 4.202*** | 3.763*** |
| 5 | 3.994*** | 3.969*** | 4.005*** | 4.076*** | 3.724*** | 3.801*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.447*** | 6.231*** | 6.099*** | 5.793*** | 5.226*** | 5.144*** |
| 1 | 5.215*** | 5.294*** | 5.366*** | 5.037*** | 4.864*** | 5.057*** |
| 2 | 5.042*** | 5.062*** | 4.978*** | 4.799*** | 4.712*** | 4.508*** |
| 3 | 4.546*** | 4.503*** | 4.292*** | 4.450*** | 4.493*** | 4.630*** |
| 4 | 4.313*** | 4.194*** | 4.300*** | 4.317*** | 4.430*** | 4.299*** |
| 5 | 4.577*** | 4.541*** | 4.391*** | 4.487*** | 4.370*** | 4.133*** |

***f = 1***

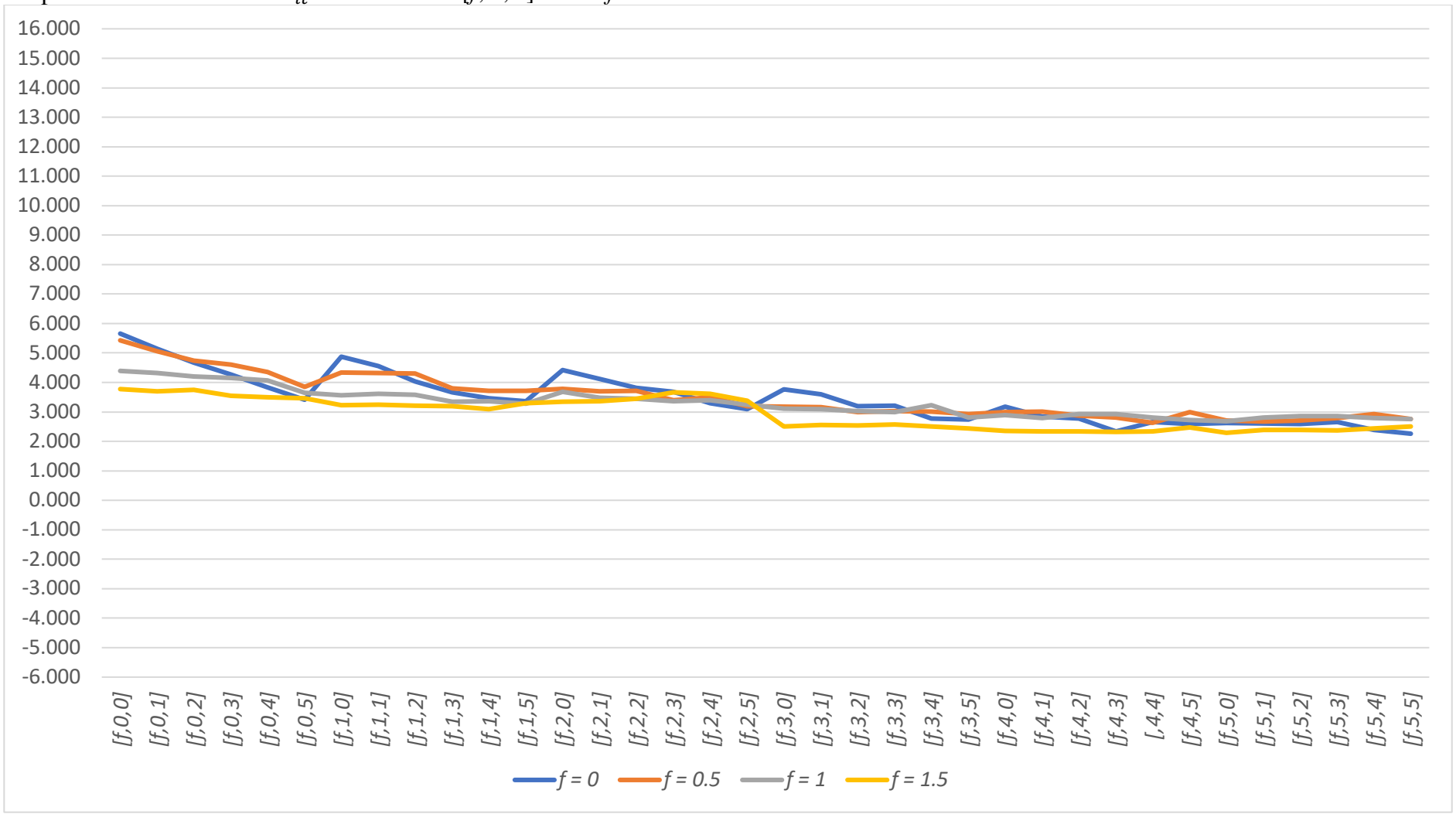
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.682*** | 6.231*** | 5.772*** | 5.505*** | 5.652*** | 4.867*** |
| 1 | 5.010*** | 5.035*** | 5.019*** | 4.959*** | 4.643*** | 4.850*** |
| 2 | 4.917*** | 4.878*** | 4.835*** | 4.675*** | 4.607*** | 4.515*** |
| 3 | 4.730*** | 4.672*** | 4.642*** | 4.553*** | 4.708*** | 4.548*** |
| 4 | 4.331*** | 4.380*** | 4.528*** | 4.605*** | 4.464*** | 4.359*** |
| 5 | 4.026*** | 4.124*** | 4.135*** | 3.984*** | 3.987*** | 3.851*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.050*** | 5.215*** | 5.294*** | 5.366*** | 5.037*** | 4.864*** |
| 1 | 4.498*** | 4.446*** | 4.370*** | 4.310*** | 4.297*** | 4.237*** |
| 2 | 4.381*** | 4.404*** | 4.419*** | 4.354*** | 4.398*** | 4.350*** |
| 3 | 4.113*** | 4.032*** | 4.078*** | 4.123*** | 4.046*** | 4.179*** |
| 4 | 4.082*** | 4.113*** | 4.064*** | 4.071*** | 4.152*** | 3.945*** |
| 5 | 4.043*** | 3.839*** | 4.050*** | 3.861*** | 3.809*** | 3.806*** |

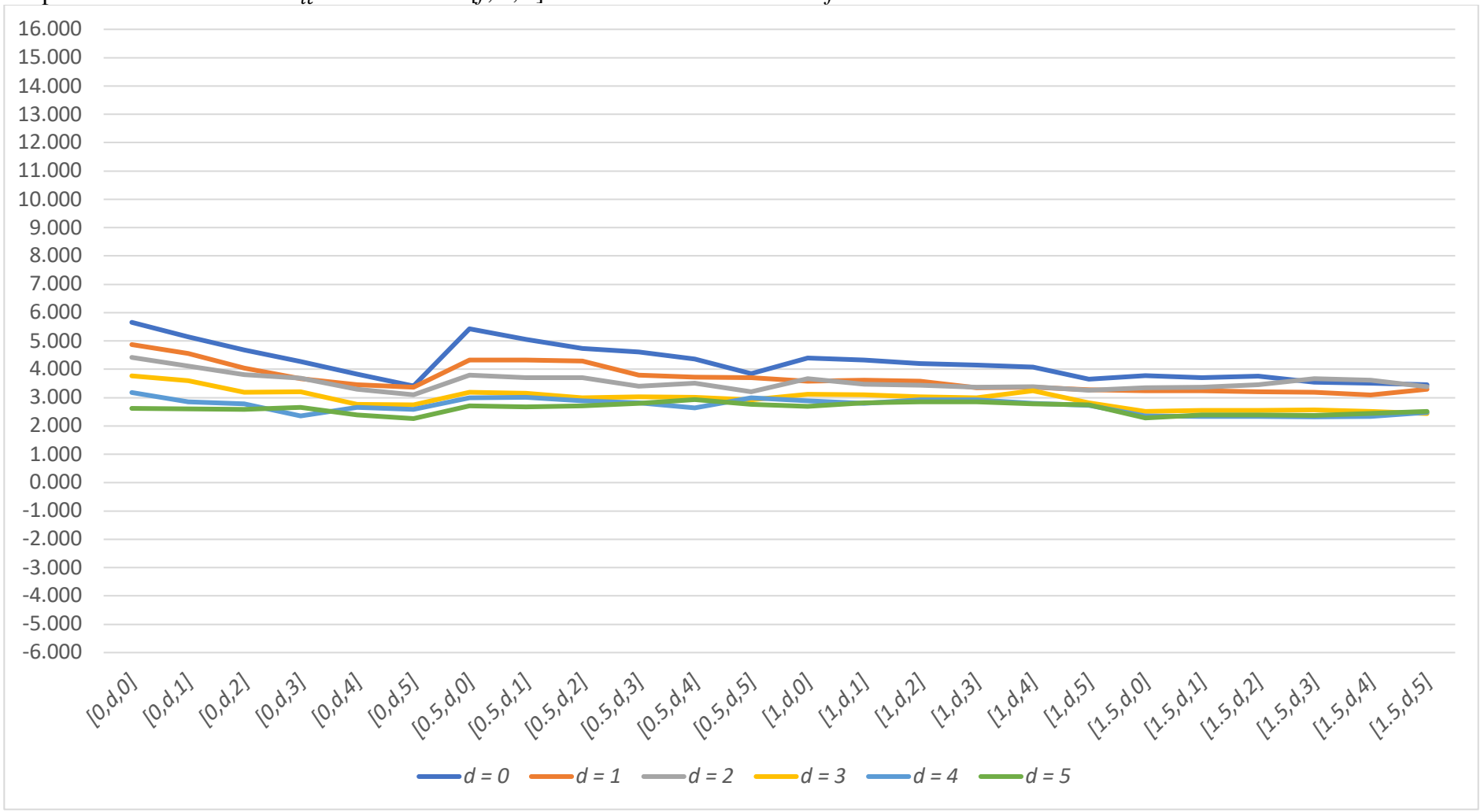
**Appendix 181: EW Europe S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



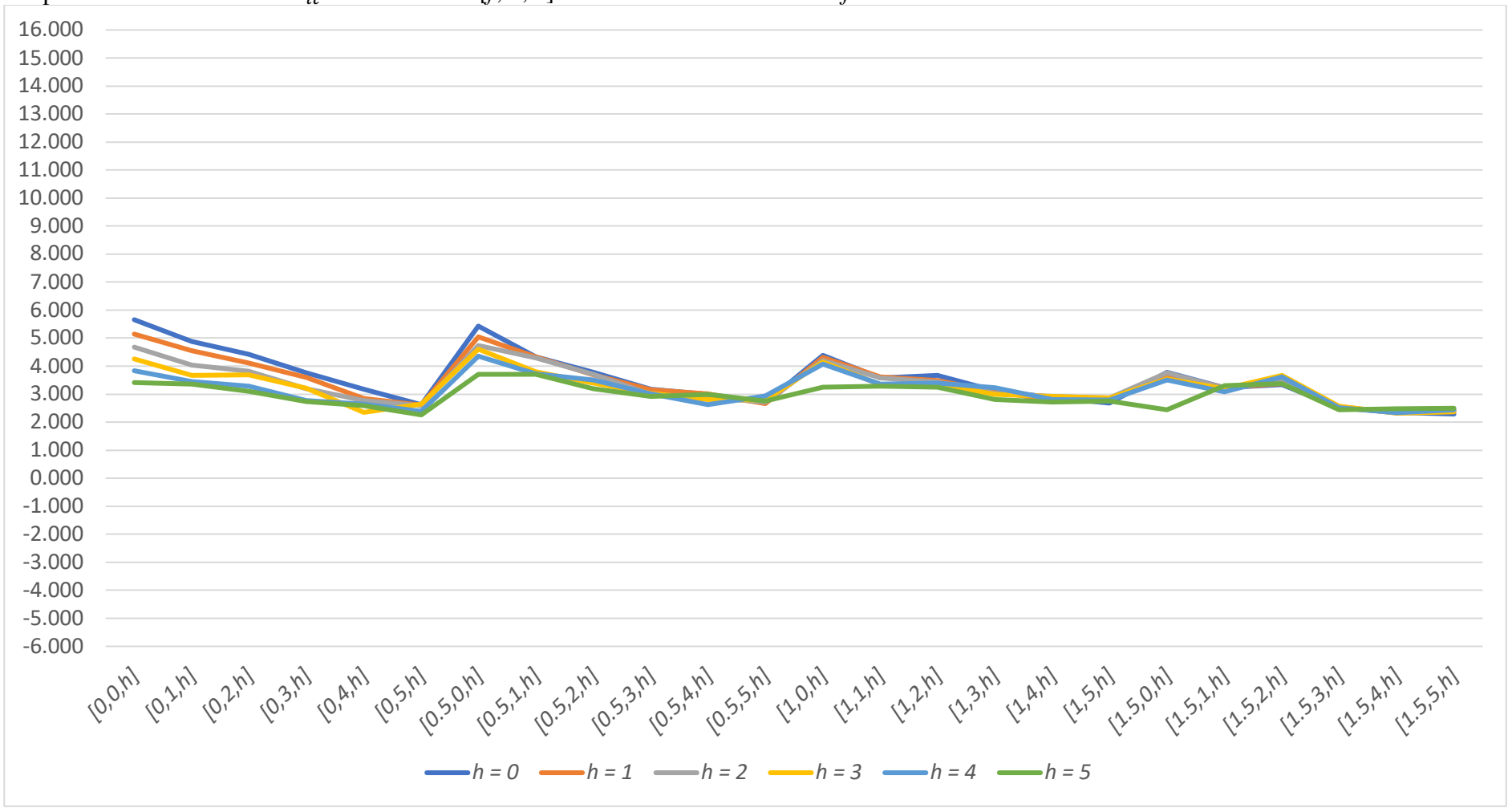
**Appendix 182: EW Europe S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 183: EW Europe S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 184: EW Europe S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.657*** | 5.144*** | 4.679*** | 4.266*** | 3.833*** | 3.410*** |
| 1 | 4.872*** | 4.554*** | 4.042*** | 3.671*** | 3.455*** | 3.368*** |
| 2 | 4.419*** | 4.113*** | 3.811*** | 3.688*** | 3.287*** | 3.100*** |
| 3 | 3.767*** | 3.605*** | 3.187*** | 3.208*** | 2.769*** | 2.740*** |
| 4 | 3.180*** | 2.847*** | 2.779*** | 2.345** | 2.653*** | 2.585** |
| 5 | 2.620** | 2.606** | 2.589** | 2.650** | 2.387** | 2.260** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.428*** | 5.054*** | 4.735*** | 4.605*** | 4.356*** | 3.851*** |
| 1 | 4.331*** | 4.324*** | 4.296*** | 3.797*** | 3.721*** | 3.708*** |
| 2 | 3.787*** | 3.696*** | 3.711*** | 3.394*** | 3.503*** | 3.199*** |
| 3 | 3.182*** | 3.158*** | 2.989*** | 3.023*** | 3.006*** | 2.926*** |
| 4 | 2.989*** | 3.010*** | 2.882*** | 2.811*** | 2.630** | 3.000*** |
| 5 | 2.707** | 2.670** | 2.709** | 2.792*** | 2.930*** | 2.762*** |

***f = 1***

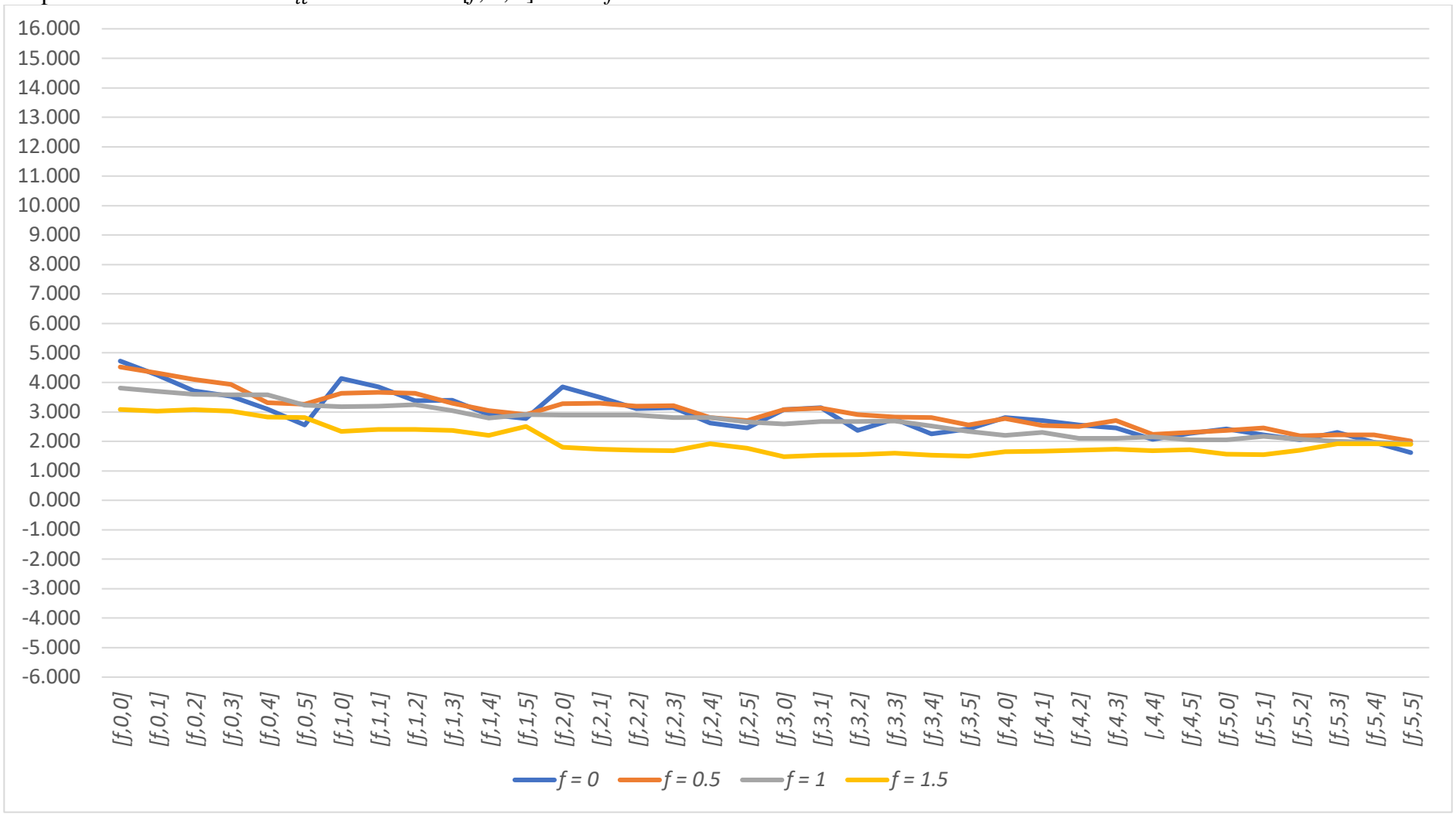
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.391*** | 4.872*** | 4.554*** | 4.042*** | 3.671*** | 3.455*** |
| 1 | 3.571*** | 3.609*** | 3.585*** | 3.348*** | 3.368*** | 3.277*** |
| 2 | 3.677*** | 3.479*** | 3.438*** | 3.365*** | 3.388*** | 3.252*** |
| 3 | 3.114*** | 3.092*** | 3.029*** | 2.994*** | 3.235*** | 2.814*** |
| 4 | 2.884*** | 2.792*** | 2.923*** | 2.926*** | 2.805*** | 2.718** |
| 5 | 2.683** | 2.811*** | 2.858*** | 2.855*** | 2.786*** | 2.752** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.774*** | 4.331*** | 4.324*** | 4.296*** | 3.797*** | 3.721*** |
| 1 | 3.235*** | 3.237*** | 3.212*** | 3.191*** | 3.093*** | 3.298*** |
| 2 | 3.346*** | 3.370*** | 3.450*** | 3.672*** | 3.612*** | 3.380*** |
| 3 | 2.513** | 2.550** | 2.542** | 2.575** | 2.508** | 2.437** |
| 4 | 2.347** | 2.333** | 2.342** | 2.320** | 2.336** | 2.472** |
| 5 | 2.290** | 2.381** | 2.386** | 2.377** | 2.436** | 2.505** |

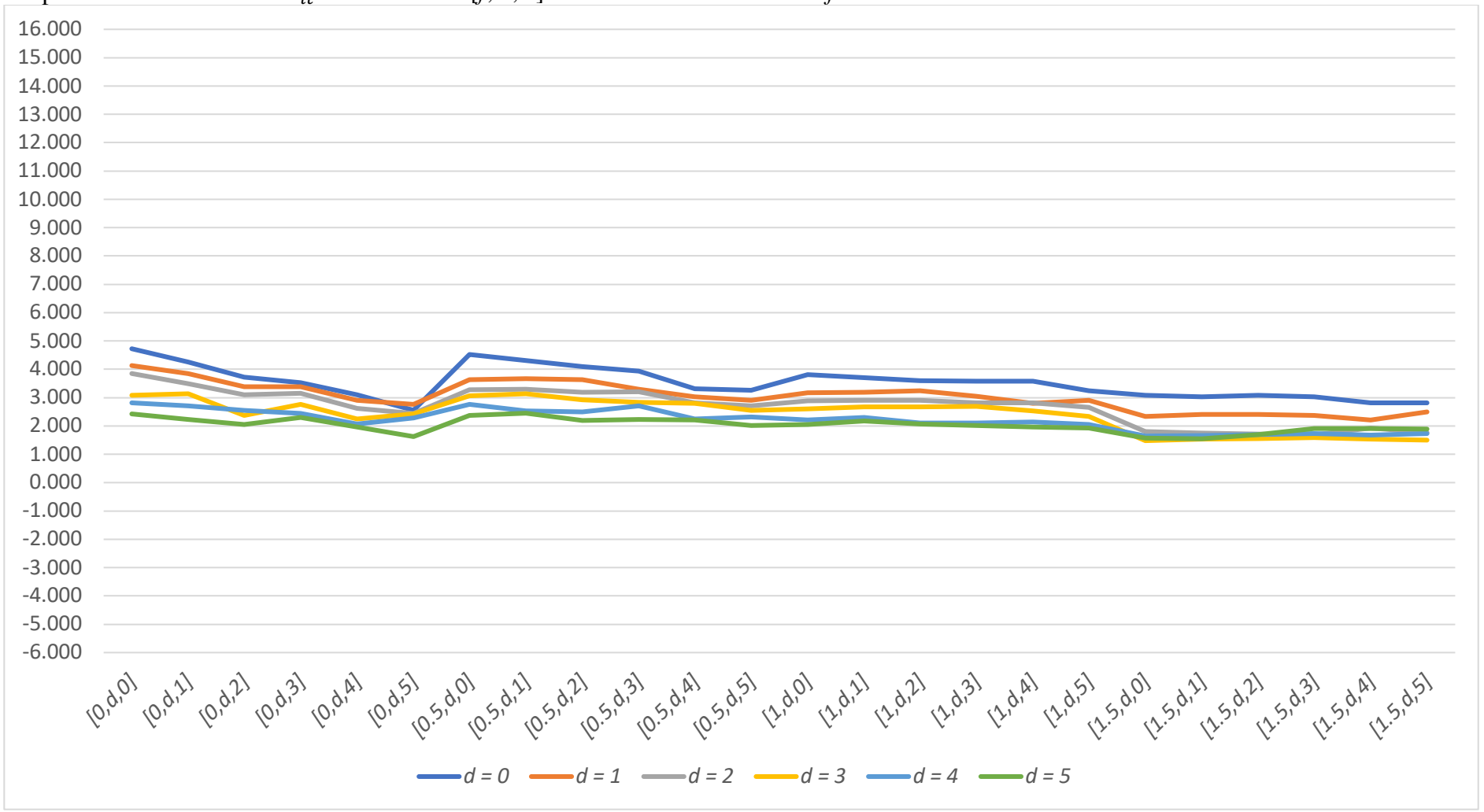
**Appendix 185: EW Europe S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



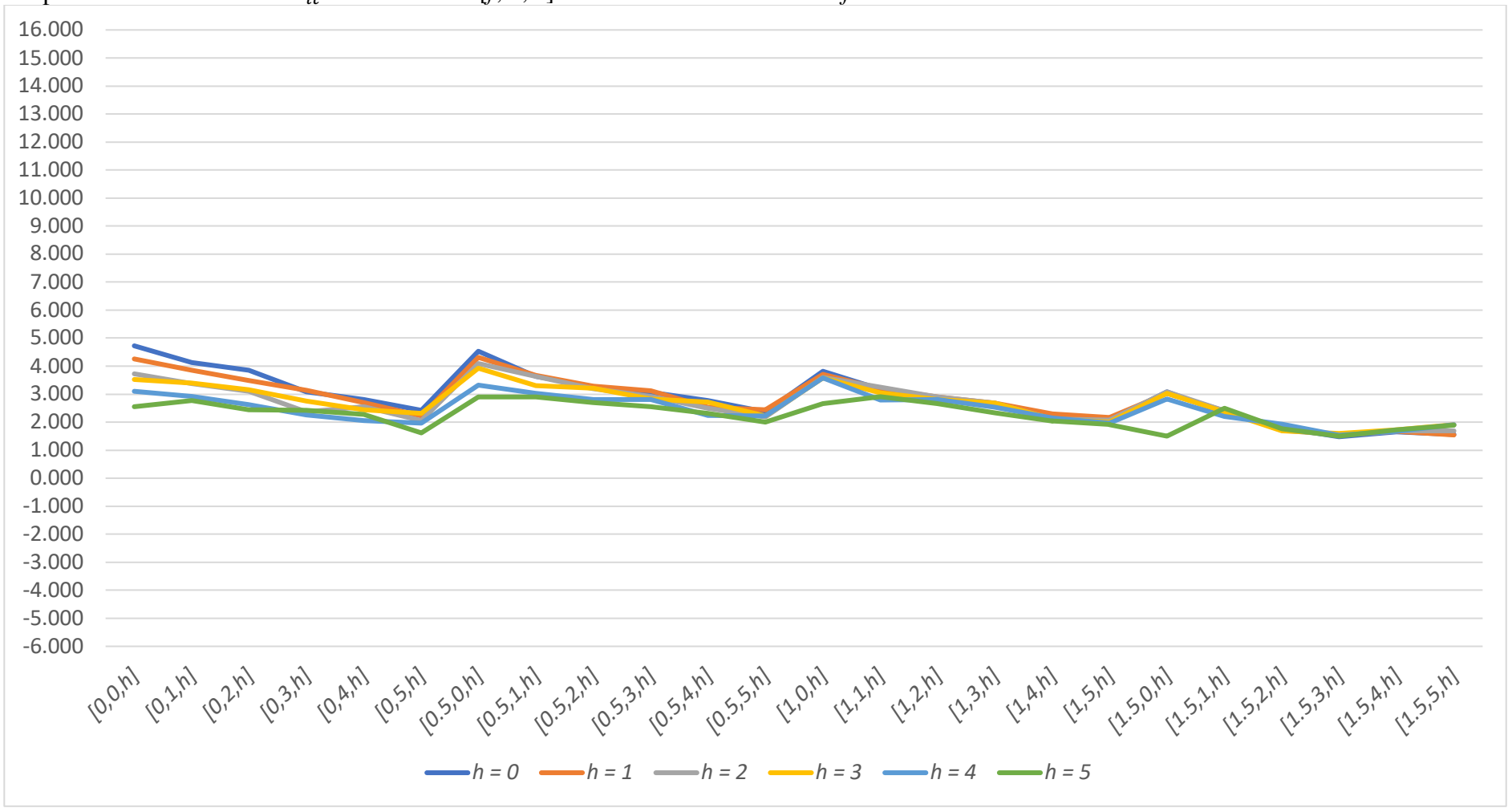
**Appendix 186: EW Europe S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 187: EW Europe S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 188: EW Europe S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.725*** | 4.257*** | 3.722*** | 3.529*** | 3.099*** | 2.555*** |
| 1 | 4.131*** | 3.852*** | 3.382*** | 3.393*** | 2.910*** | 2.767*** |
| 2 | 3.850*** | 3.490*** | 3.102*** | 3.149*** | 2.627*** | 2.447*** |
| 3 | 3.079*** | 3.136*** | 2.367** | 2.757*** | 2.251** | 2.424** |
| 4 | 2.816*** | 2.706*** | 2.553*** | 2.448** | 2.066** | 2.277** |
| 5 | 2.423** | 2.222** | 2.053** | 2.306** | 1.966** | 1.618* |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.524*** | 4.314*** | 4.093*** | 3.927*** | 3.318*** | 3.264*** |
| 1 | 3.637*** | 3.668*** | 3.635*** | 3.301*** | 3.035*** | 2.904*** |
| 2 | 3.272*** | 3.291*** | 3.190*** | 3.204*** | 2.816*** | 2.700*** |
| 3 | 3.071*** | 3.127*** | 2.914*** | 2.830*** | 2.801*** | 2.556*** |
| 4 | 2.766*** | 2.538** | 2.501** | 2.711*** | 2.239** | 2.310** |
| 5 | 2.375** | 2.450** | 2.194** | 2.223** | 2.214** | 2.011** |

***f = 1***

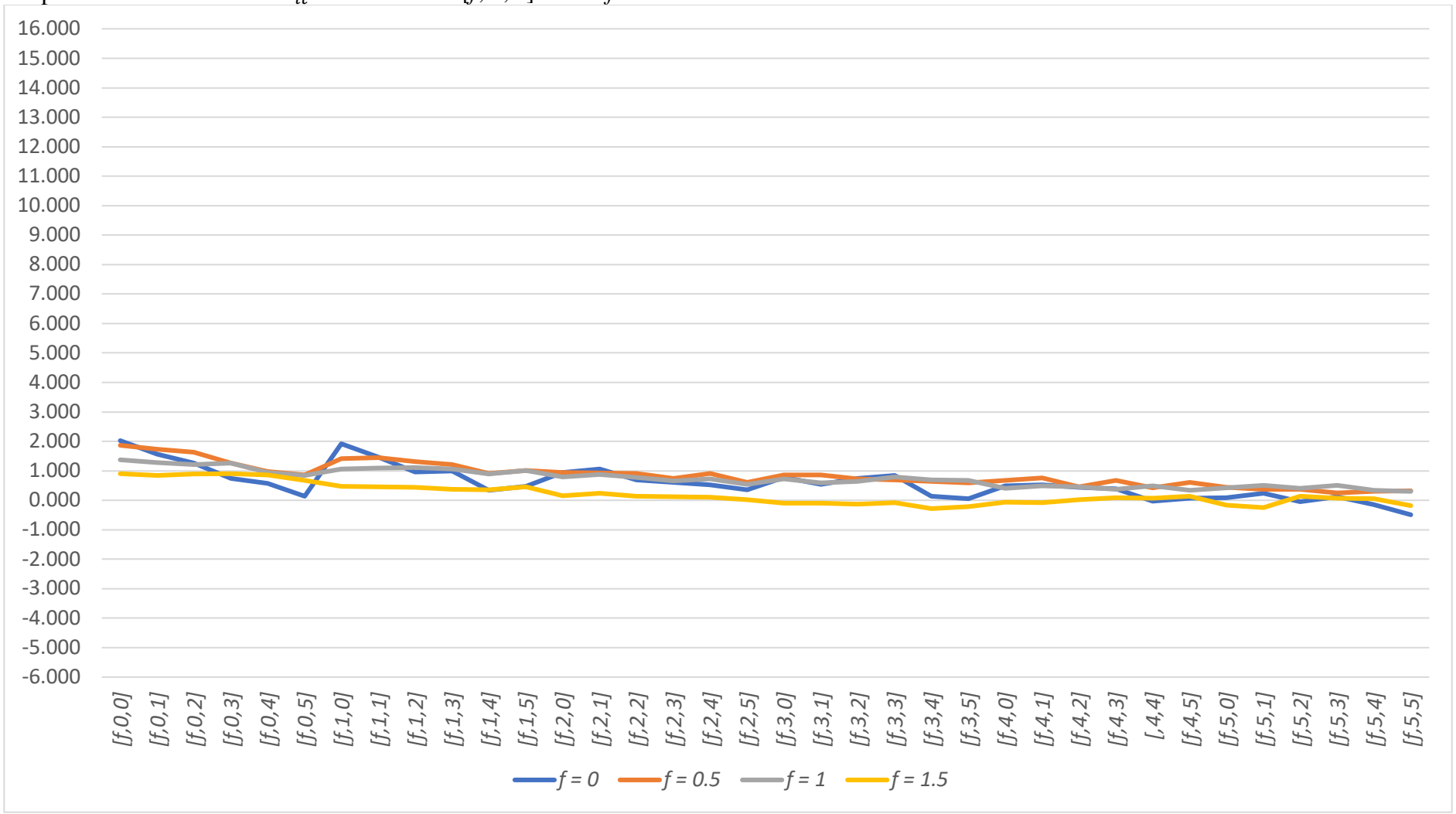
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.809*** | 4.131*** | 3.852*** | 3.382*** | 3.393*** | 2.910*** |
| 1 | 3.177*** | 3.196*** | 3.242*** | 3.050*** | 2.798*** | 2.910*** |
| 2 | 2.890*** | 2.900*** | 2.900*** | 2.814*** | 2.812*** | 2.654*** |
| 3 | 2.597*** | 2.672*** | 2.674*** | 2.686*** | 2.530** | 2.331** |
| 4 | 2.207** | 2.298** | 2.105** | 2.106** | 2.148** | 2.044** |
| 5 | 2.056** | 2.173** | 2.072** | 2.009** | 1.970* | 1.919* |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.082*** | 3.637*** | 3.668*** | 3.635*** | 3.301*** | 3.035*** |
| 1 | 2.336** | 2.406** | 2.408** | 2.372** | 2.209** | 2.504** |
| 2 | 1.796* | 1.741* | 1.706* | 1.686* | 1.924* | 1.765* |
| 3 | 1.480 | 1.532 | 1.547 | 1.597 | 1.535 | 1.502 |
| 4 | 1.645* | 1.666* | 1.693* | 1.728* | 1.679* | 1.722* |
| 5 | 1.562 | 1.546 | 1.694* | 1.917* | 1.910* | 1.897* |

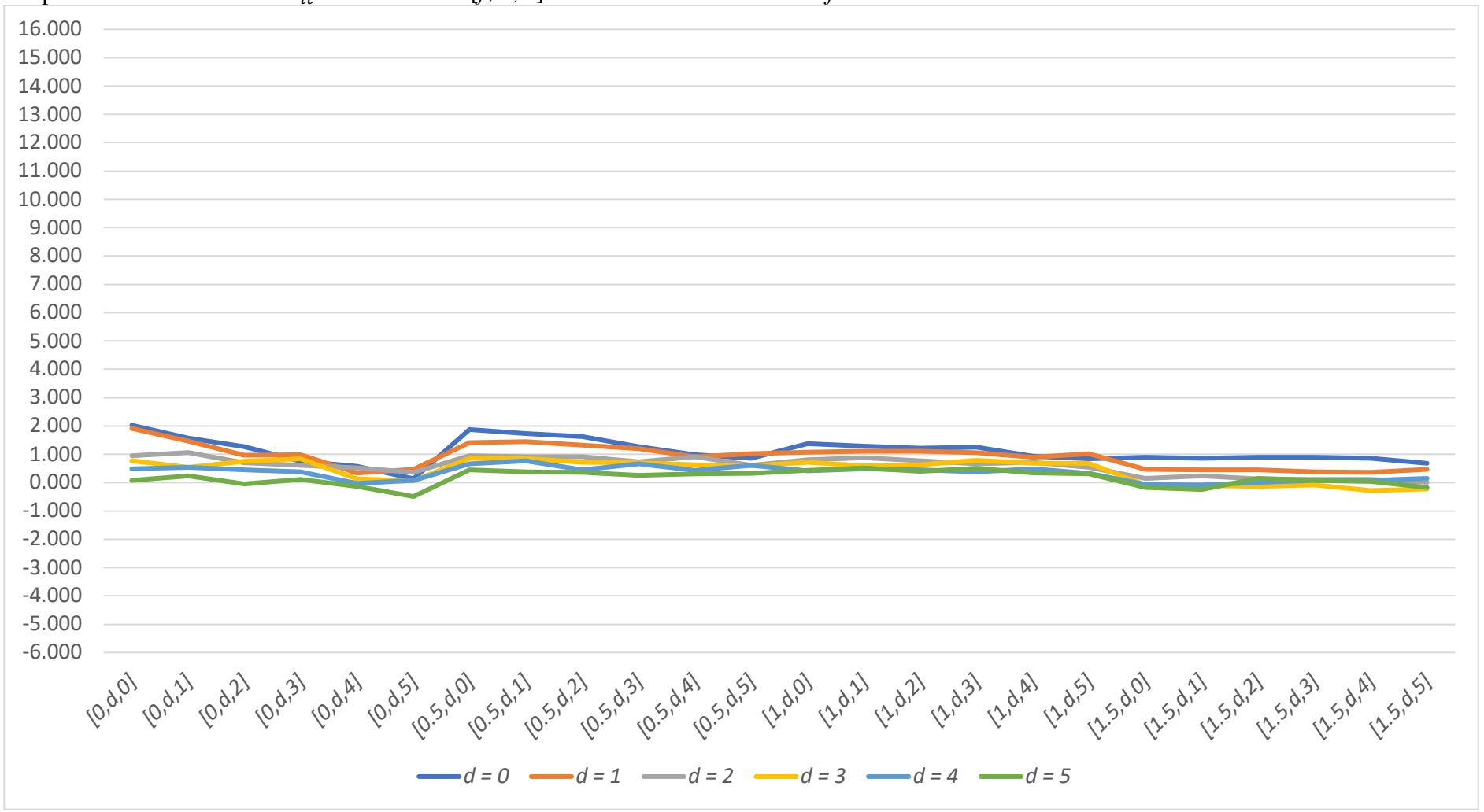
**Appendix 189: EW Europe S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



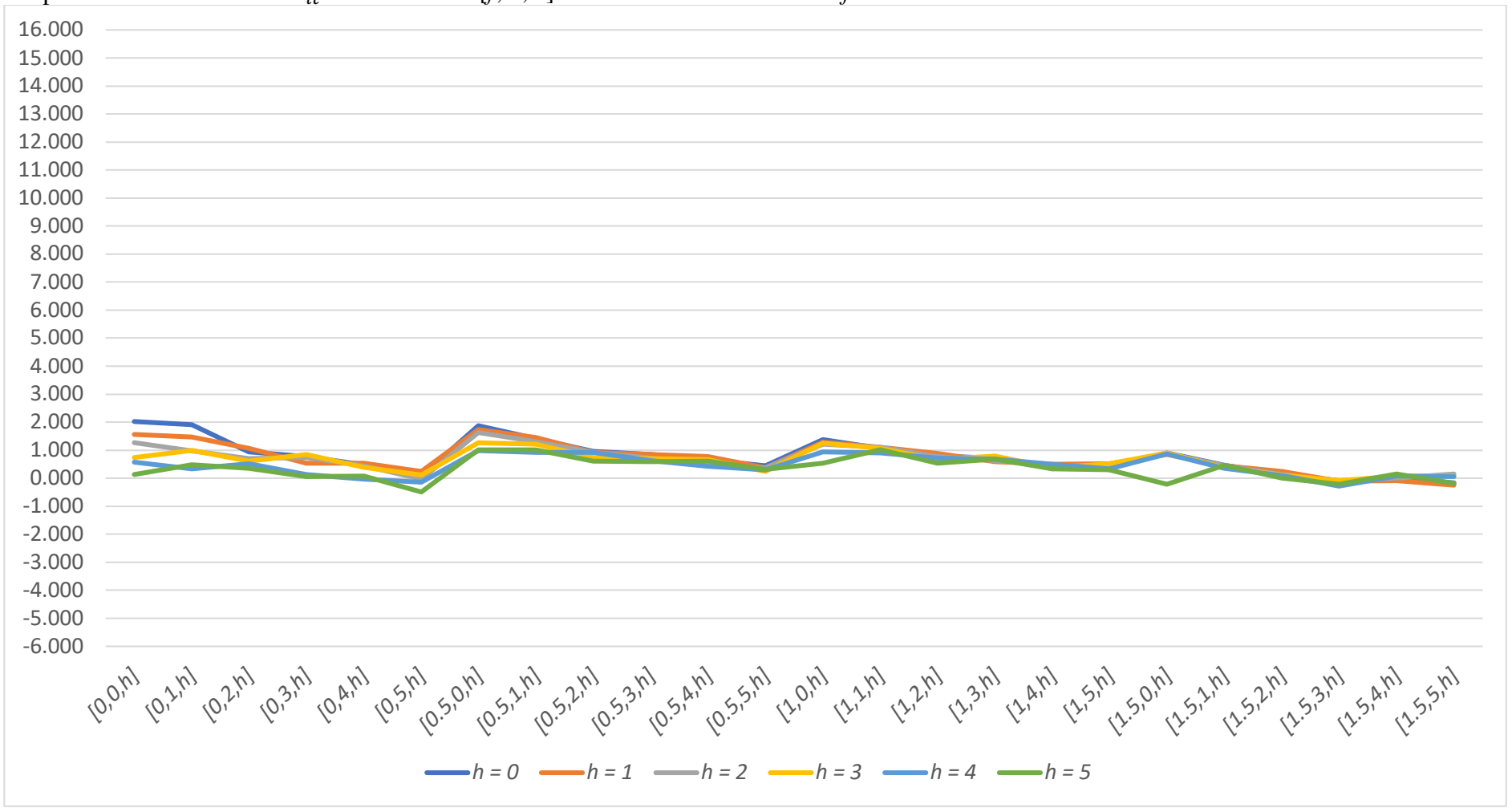
**Appendix 190: EW Europe S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 191: EW Europe S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 192: EW Europe S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.024** | 1.563* | 1.264 | 0.745 | 0.568 | 0.137 |
| 1 | 1.913** | 1.471* | 0.969 | 0.991 | 0.339 | 0.472 |
| 2 | 0.941 | 1.060 | 0.695 | 0.606 | 0.523 | 0.353 |
| 3 | 0.769 | 0.543 | 0.746 | 0.846 | 0.136 | 0.062 |
| 4 | 0.487 | 0.531 | 0.448 | 0.387 | -0.031 | 0.073 |
| 5 | 0.080 | 0.242 | -0.041 | 0.119 | -0.140 | -0.491 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 1.866** | 1.736** | 1.631* | 1.266 | 0.985 | 0.862 |
| 1 | 1.411 | 1.455* | 1.314 | 1.206 | 0.915 | 1.011 |
| 2 | 0.949 | 0.921 | 0.918 | 0.739 | 0.916 | 0.605 |
| 3 | 0.852 | 0.853 | 0.723 | 0.696 | 0.635 | 0.594 |
| 4 | 0.669 | 0.767 | 0.452 | 0.671 | 0.429 | 0.614 |
| 5 | 0.443 | 0.379 | 0.366 | 0.249 | 0.301 | 0.324 |

***f = 1***

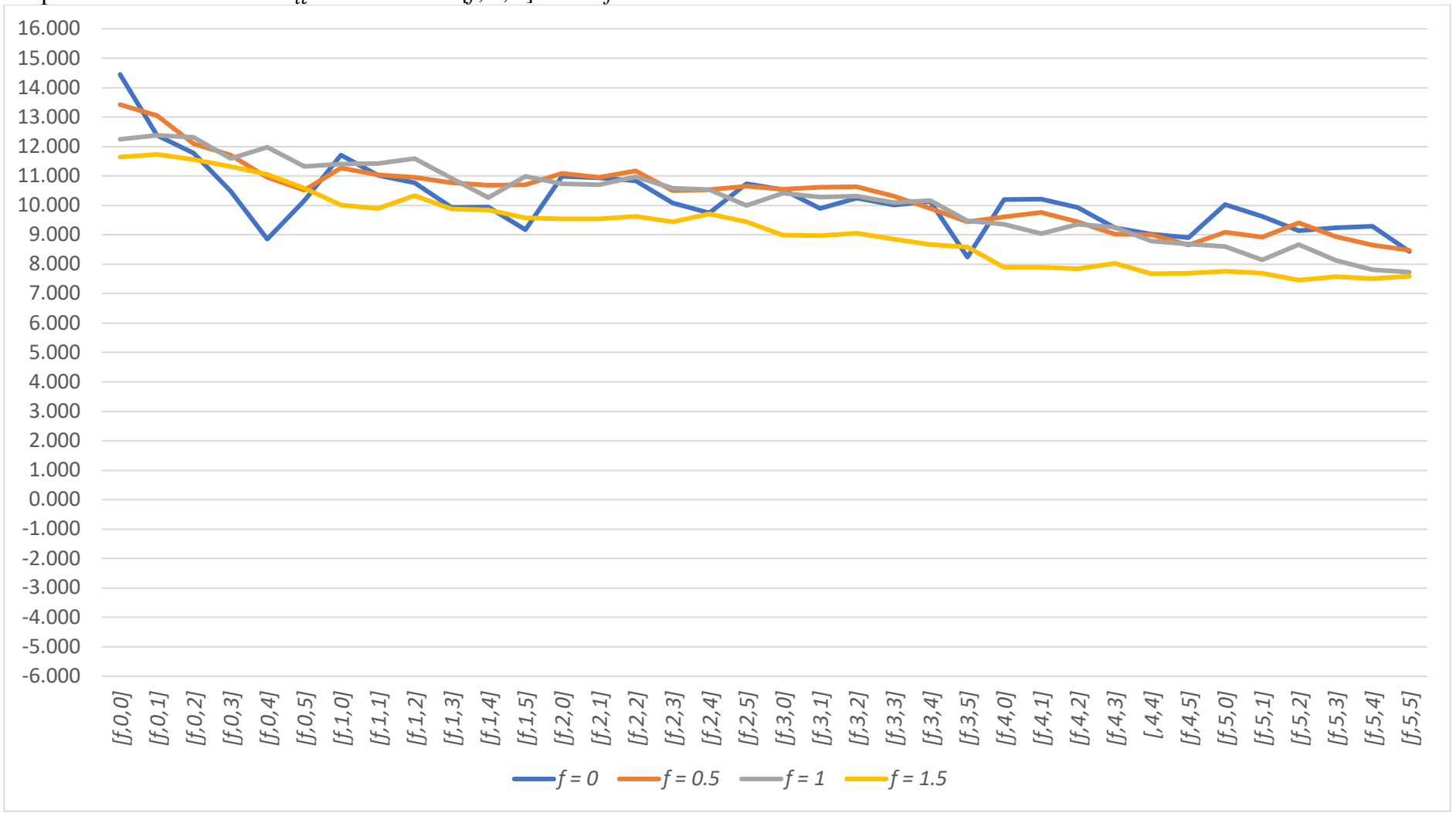
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 1.374 | 1.913** | 1.471* | 0.969 | 0.991 | 0.339 |
| 1 | 1.064 | 1.100 | 1.109 | 1.059 | 0.897 | 1.018 |
| 2 | 0.801 | 0.878 | 0.768 | 0.665 | 0.719 | 0.539 |
| 3 | 0.720 | 0.590 | 0.636 | 0.790 | 0.689 | 0.676 |
| 4 | 0.409 | 0.493 | 0.455 | 0.377 | 0.494 | 0.334 |
| 5 | 0.430 | 0.515 | 0.400 | 0.510 | 0.342 | 0.302 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0.903 | 1.411 | 1.455* | 1.314 | 1.206 | 0.915 |
| 1 | 0.469 | 0.451 | 0.442 | 0.375 | 0.355 | 0.463 |
| 2 | 0.150 | 0.234 | 0.135 | 0.114 | 0.104 | 0.013 |
| 3 | -0.091 | -0.104 | -0.131 | -0.085 | -0.282 | -0.223 |
| 4 | -0.059 | -0.084 | 0.013 | 0.081 | 0.074 | 0.142 |
| 5 | -0.164 | -0.248 | 0.145 | 0.069 | 0.050 | -0.173 |

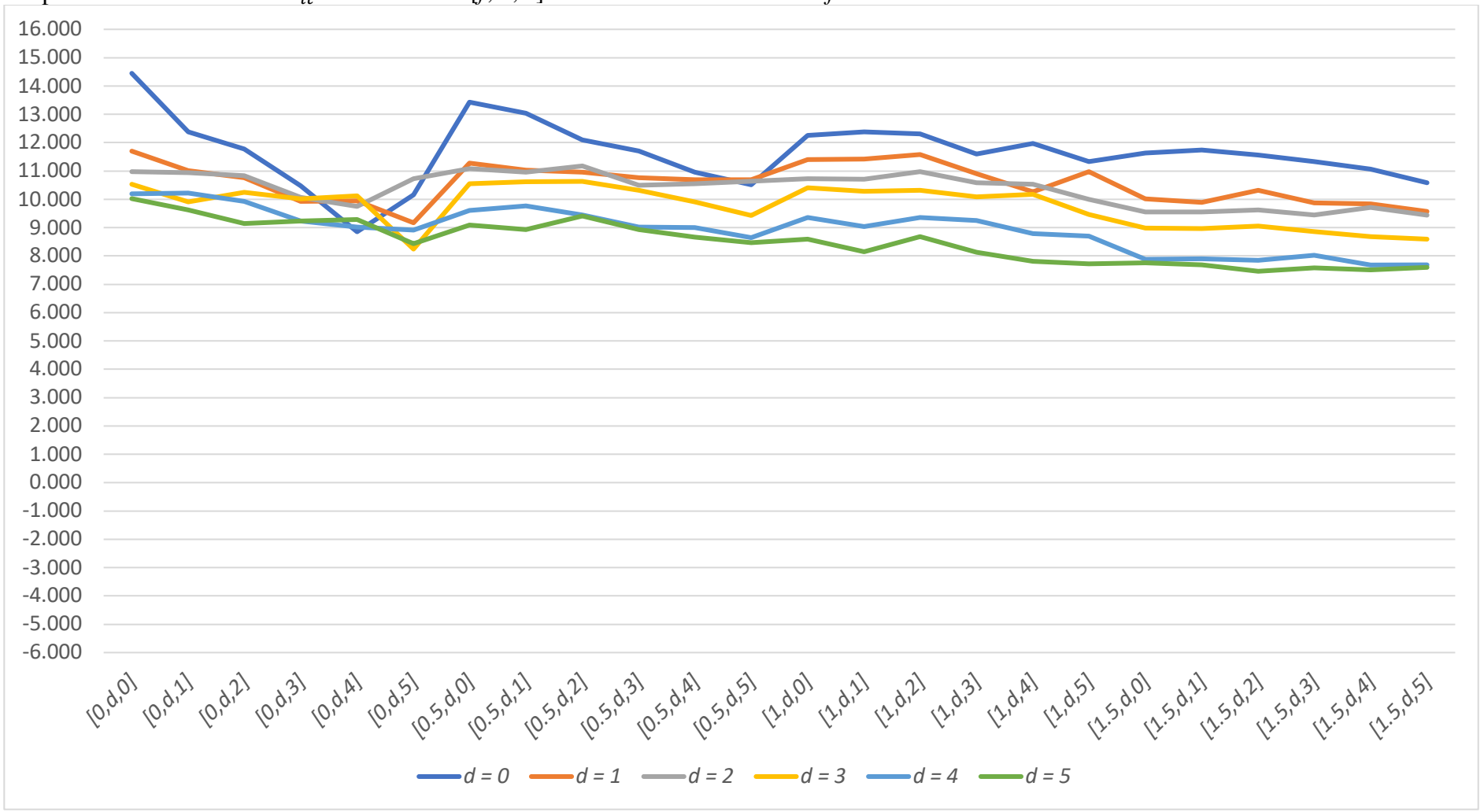
**Appendix 193: VW North America S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



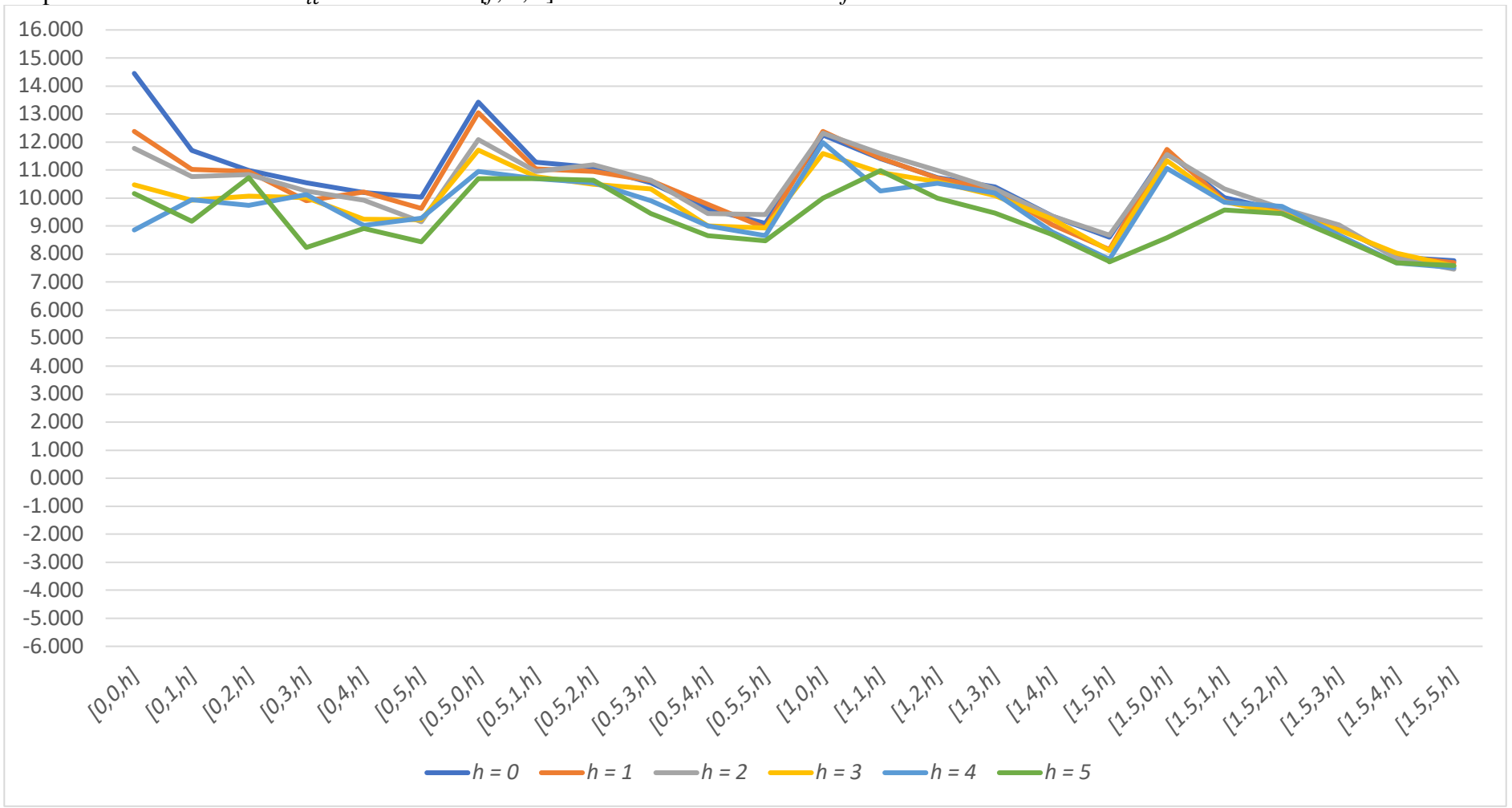
**Appendix 194: VW North America S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 195: VW North America S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 196: VW North America S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.448*** | 12.378*** | 11.774*** | 10.477*** | 8.854*** | 10.156*** |
| 1 | 11.701*** | 11.013*** | 10.762*** | 9.921*** | 9.937*** | 9.171*** |
| 2 | 10.984*** | 10.940*** | 10.834*** | 10.074*** | 9.743*** | 10.734*** |
| 3 | 10.540*** | 9.902*** | 10.248*** | 10.008*** | 10.126*** | 8.243*** |
| 4 | 10.191*** | 10.221*** | 9.927*** | 9.236*** | 9.029*** | 8.912*** |
| 5 | 10.024*** | 9.625*** | 9.145*** | 9.234*** | 9.284*** | 8.433*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.424*** | 13.046*** | 12.092*** | 11.711*** | 10.956*** | 10.511*** |
| 1 | 11.279*** | 11.033*** | 10.950*** | 10.765*** | 10.691*** | 10.700*** |
| 2 | 11.091*** | 10.953*** | 11.178*** | 10.494*** | 10.541*** | 10.645*** |
| 3 | 10.554*** | 10.614*** | 10.633*** | 10.316*** | 9.901*** | 9.438*** |
| 4 | 9.605*** | 9.766*** | 9.444*** | 9.014*** | 9.010*** | 8.649*** |
| 5 | 9.090*** | 8.929*** | 9.404*** | 8.932*** | 8.658*** | 8.475*** |

***f = 1***

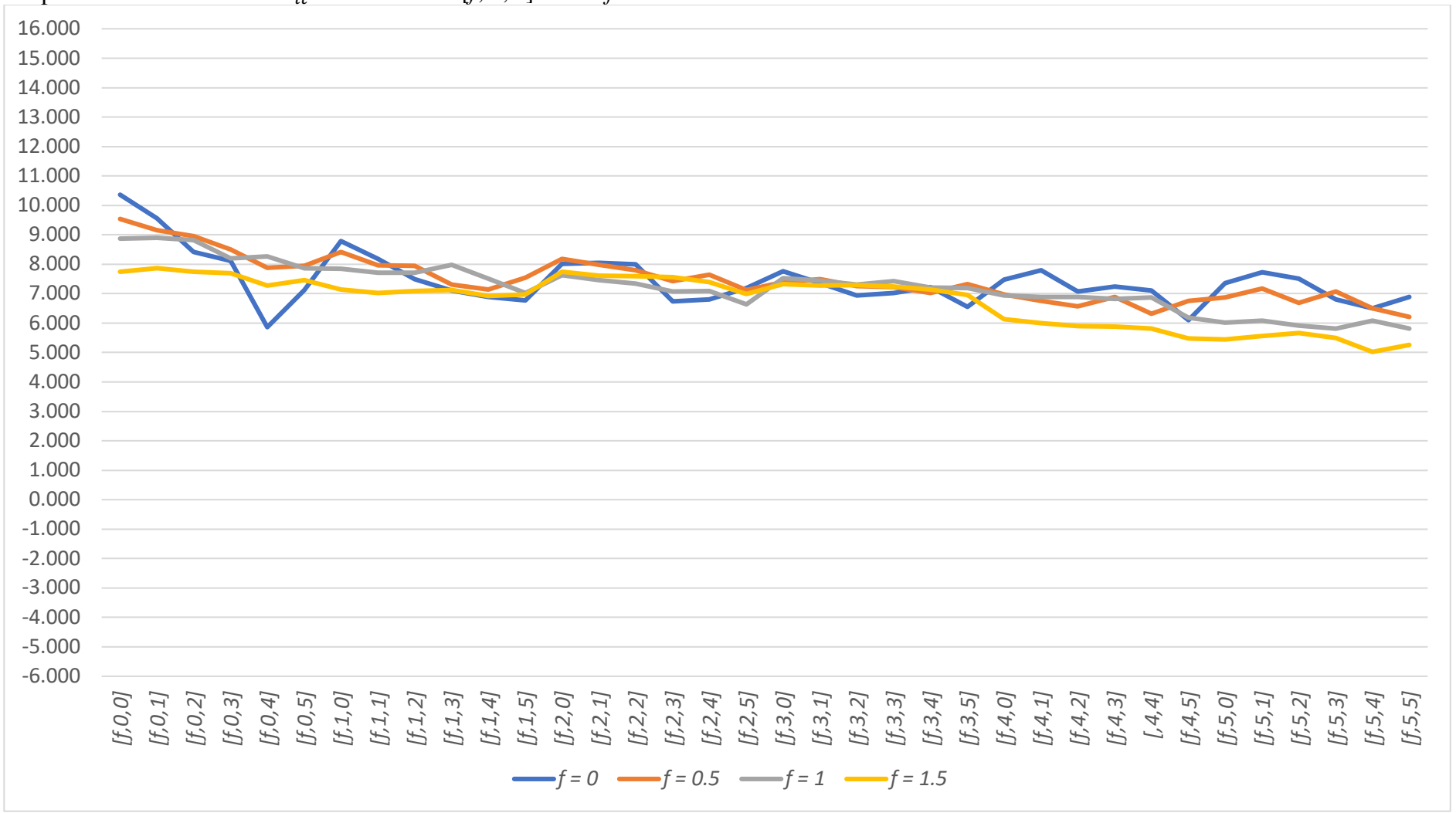
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.252*** | 11.701*** | 11.013*** | 10.762*** | 9.921*** | 9.937*** |
| 1 | 11.400*** | 11.417*** | 11.584*** | 10.912*** | 10.257*** | 10.979*** |
| 2 | 10.735*** | 10.707*** | 10.976*** | 10.577*** | 10.525*** | 9.995*** |
| 3 | 10.407*** | 10.286*** | 10.322*** | 10.092*** | 10.170*** | 9.467*** |
| 4 | 9.358*** | 9.041*** | 9.353*** | 9.252*** | 8.792*** | 8.693*** |
| 5 | 8.598*** | 8.154*** | 8.676*** | 8.124*** | 7.808*** | 7.731*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.641*** | 11.279*** | 11.033*** | 10.950*** | 10.765*** | 10.691*** |
| 1 | 10.020*** | 9.889*** | 10.323*** | 9.872*** | 9.844*** | 9.575*** |
| 2 | 9.548*** | 9.545*** | 9.624*** | 9.443*** | 9.707*** | 9.441*** |
| 3 | 8.990*** | 8.967*** | 9.049*** | 8.855*** | 8.676*** | 8.591*** |
| 4 | 7.890*** | 7.904*** | 7.849*** | 8.030*** | 7.681*** | 7.693*** |
| 5 | 7.765*** | 7.694*** | 7.460*** | 7.573*** | 7.517*** | 7.591*** |

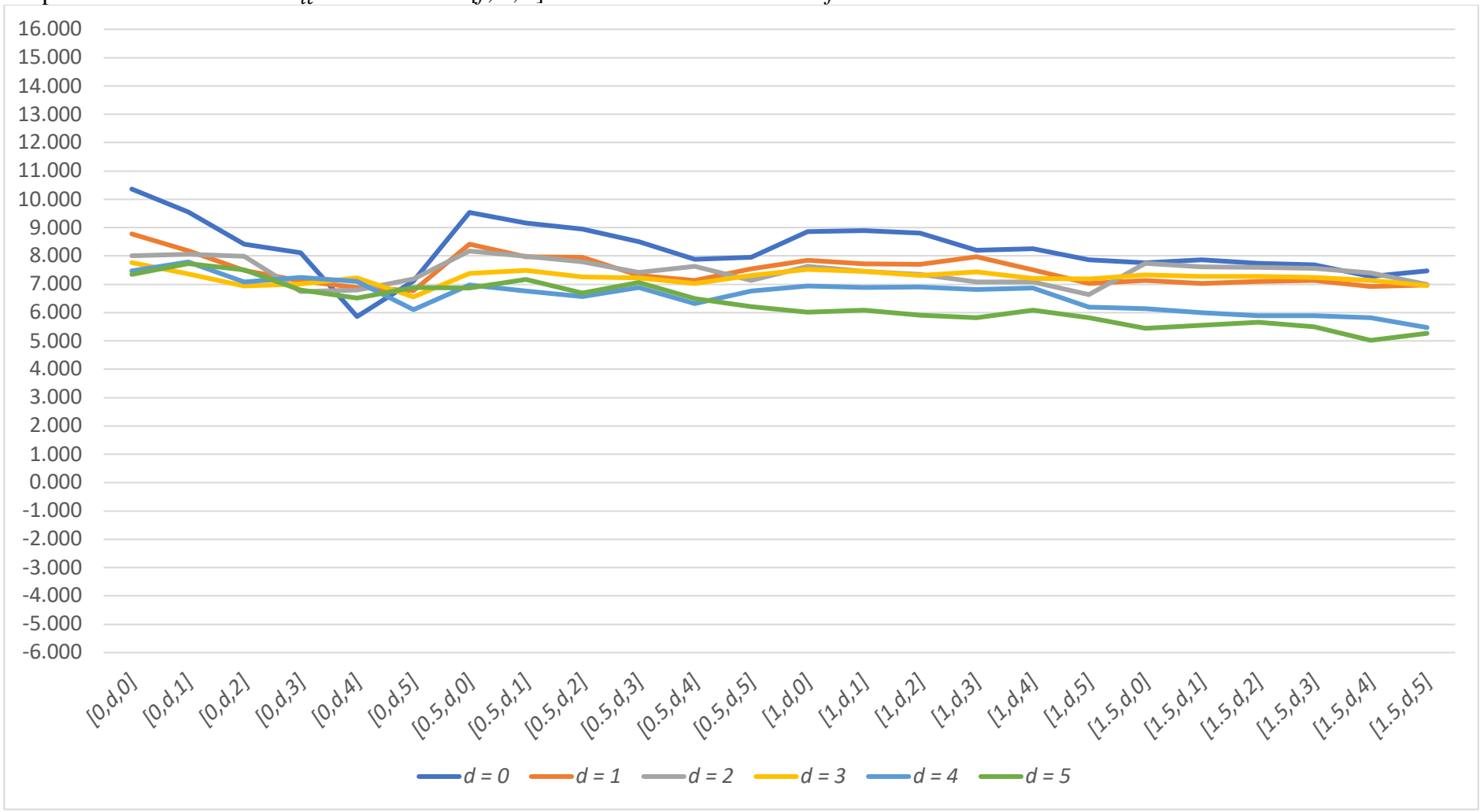
**Appendix 197: VW North America S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



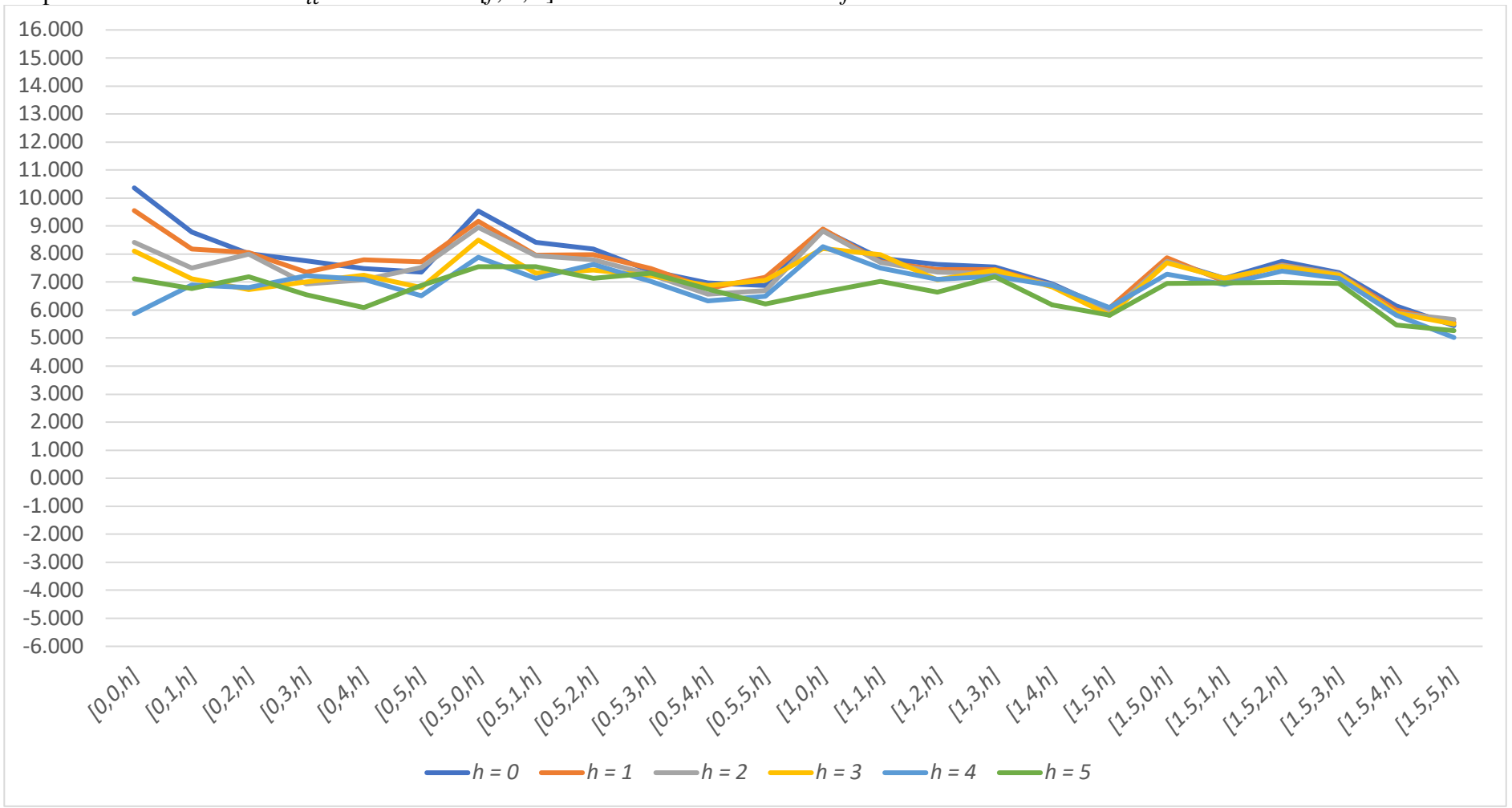
**Appendix 198: VW North America S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 199: VW North America S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 200: VW North America S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.362*** | 9.552*** | 8.418*** | 8.109*** | 5.862*** | 7.123*** |
| 1 | 8.778*** | 8.188*** | 7.494*** | 7.114*** | 6.892*** | 6.774*** |
| 2 | 8.014*** | 8.052*** | 7.994*** | 6.741*** | 6.805*** | 7.189*** |
| 3 | 7.765*** | 7.361*** | 6.933*** | 7.015*** | 7.222*** | 6.555*** |
| 4 | 7.481*** | 7.788*** | 7.075*** | 7.248*** | 7.104*** | 6.096*** |
| 5 | 7.354*** | 7.731*** | 7.516*** | 6.799*** | 6.507*** | 6.882*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.539*** | 9.164*** | 8.951*** | 8.499*** | 7.886*** | 7.954*** |
| 1 | 8.423*** | 7.968*** | 7.948*** | 7.314*** | 7.134*** | 7.549*** |
| 2 | 8.174*** | 7.981*** | 7.792*** | 7.421*** | 7.638*** | 7.127*** |
| 3 | 7.393*** | 7.487*** | 7.257*** | 7.225*** | 7.028*** | 7.319*** |
| 4 | 6.975*** | 6.760*** | 6.566*** | 6.887*** | 6.323*** | 6.755*** |
| 5 | 6.870*** | 7.172*** | 6.688*** | 7.065*** | 6.502*** | 6.210*** |

***f = 1***

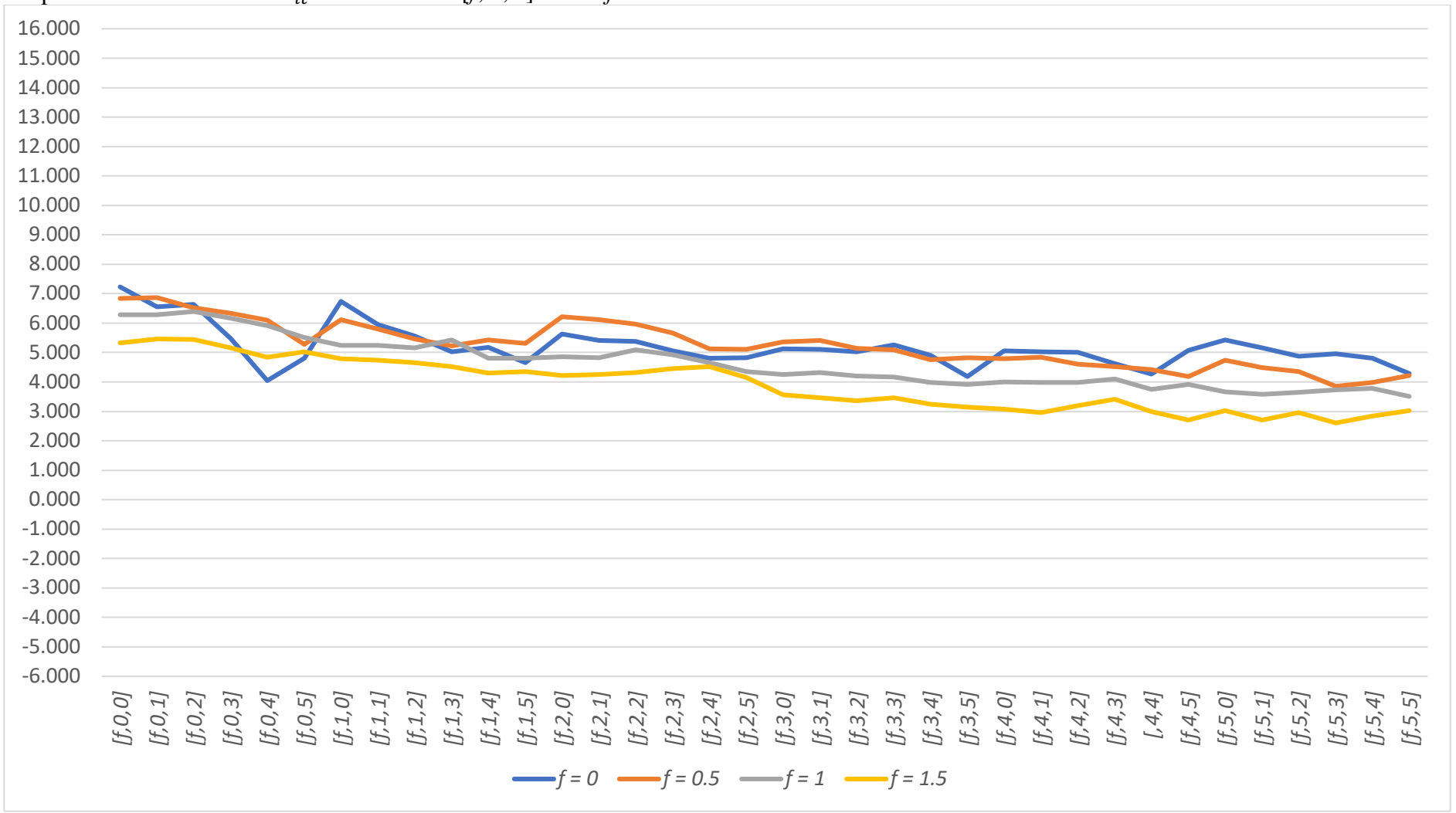
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.862*** | 8.778*** | 8.188*** | 7.494*** | 7.114*** | 6.892*** |
| 1 | 7.850*** | 7.719*** | 7.709*** | 7.973*** | 7.502*** | 7.029*** |
| 2 | 7.628*** | 7.452*** | 7.348*** | 7.075*** | 7.091*** | 6.636*** |
| 3 | 7.534*** | 7.447*** | 7.308*** | 7.430*** | 7.200*** | 7.191*** |
| 4 | 6.941*** | 6.884*** | 6.896*** | 6.819*** | 6.870*** | 6.185*** |
| 5 | 6.022*** | 6.080*** | 5.915*** | 5.812*** | 6.085*** | 5.820*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.751*** | 8.423*** | 7.968*** | 7.948*** | 7.314*** | 7.134*** |
| 1 | 7.144*** | 7.031*** | 7.096*** | 7.128*** | 6.914*** | 6.977*** |
| 2 | 7.737*** | 7.612*** | 7.600*** | 7.564*** | 7.396*** | 6.987*** |
| 3 | 7.333*** | 7.278*** | 7.285*** | 7.242*** | 7.142*** | 6.956*** |
| 4 | 6.140*** | 6.001*** | 5.896*** | 5.885*** | 5.817*** | 5.474*** |
| 5 | 5.445*** | 5.558*** | 5.665*** | 5.503*** | 5.022*** | 5.267*** |

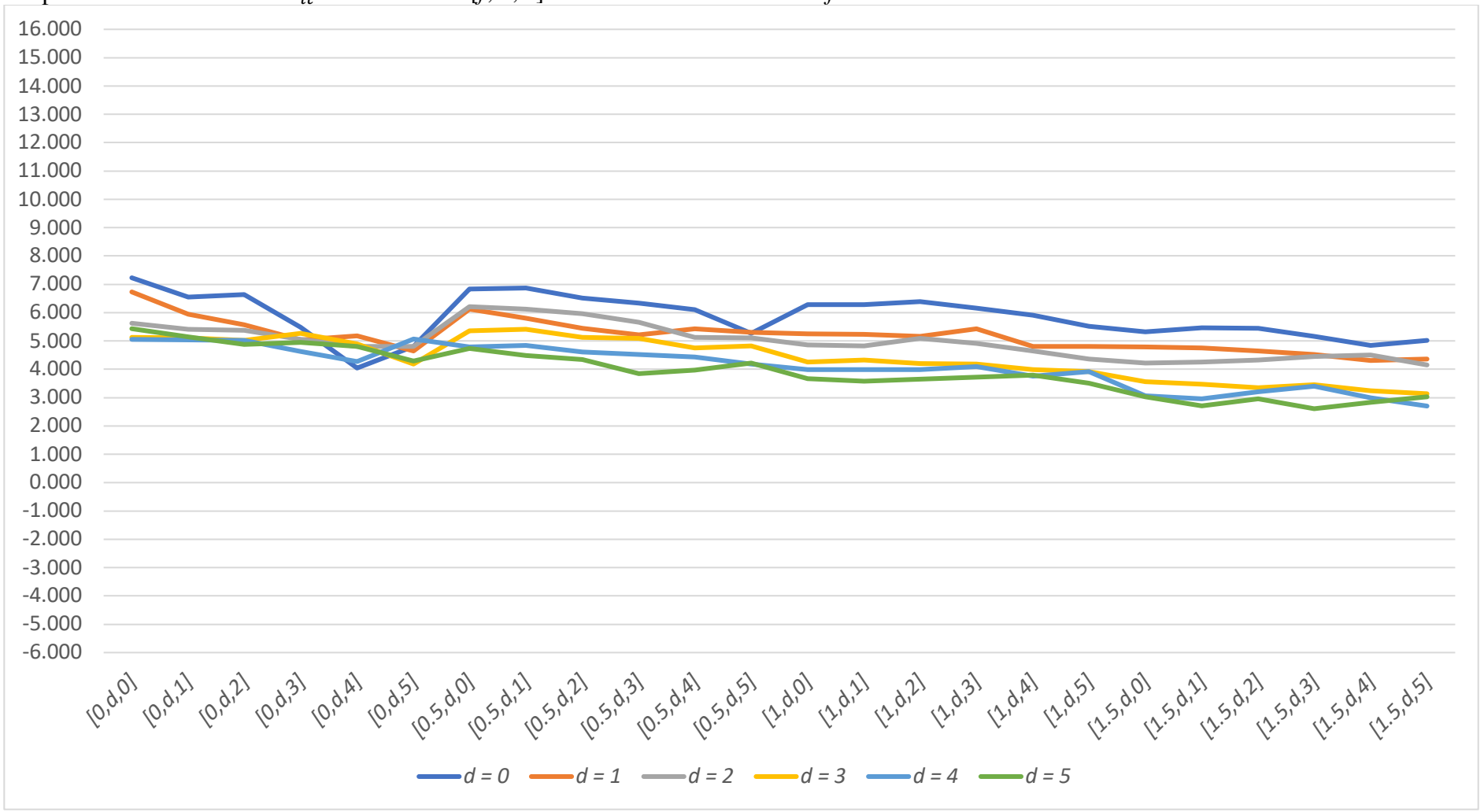
**Appendix 201: VW North America S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



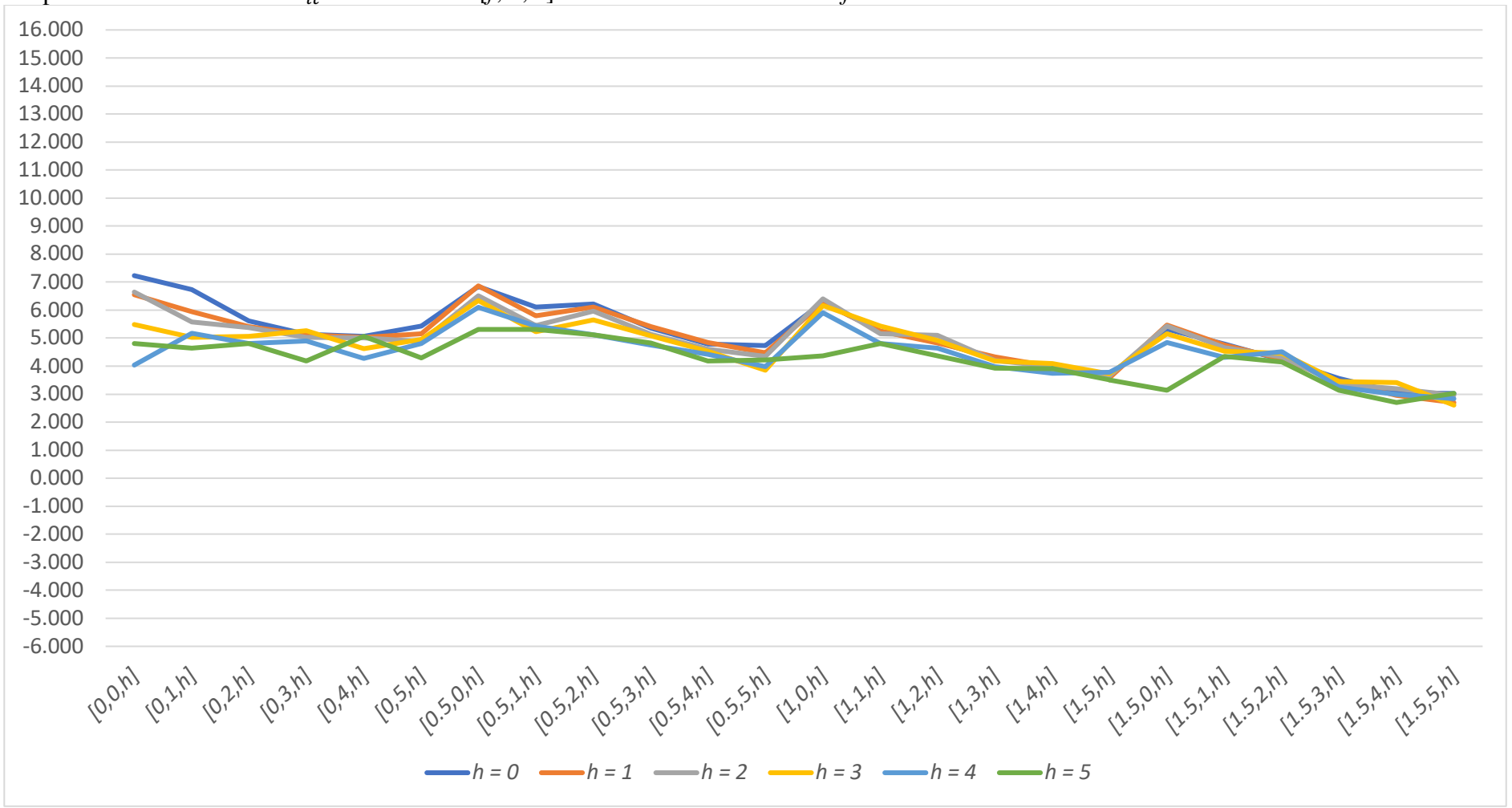
**Appendix 202: VW North America S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 203: VW North America S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 204: VW North America S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.230*** | 6.556*** | 6.645*** | 5.484*** | 4.044*** | 4.802*** |
| 1 | 6.731*** | 5.951*** | 5.568*** | 5.030*** | 5.173*** | 4.649*** |
| 2 | 5.622*** | 5.406*** | 5.374*** | 5.062*** | 4.811*** | 4.815*** |
| 3 | 5.133*** | 5.116*** | 5.024*** | 5.262*** | 4.904*** | 4.178*** |
| 4 | 5.057*** | 5.031*** | 5.014*** | 4.620*** | 4.272*** | 5.069*** |
| 5 | 5.433*** | 5.151*** | 4.879*** | 4.954*** | 4.812*** | 4.291*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.833*** | 6.866*** | 6.513*** | 6.340*** | 6.100*** | 5.273*** |
| 1 | 6.117*** | 5.803*** | 5.453*** | 5.220*** | 5.427*** | 5.311*** |
| 2 | 6.211*** | 6.115*** | 5.971*** | 5.656*** | 5.125*** | 5.110*** |
| 3 | 5.358*** | 5.413*** | 5.135*** | 5.087*** | 4.756*** | 4.830*** |
| 4 | 4.788*** | 4.845*** | 4.608*** | 4.523*** | 4.428*** | 4.179*** |
| 5 | 4.734*** | 4.479*** | 4.351*** | 3.853*** | 3.976*** | 4.212*** |

***f = 1***

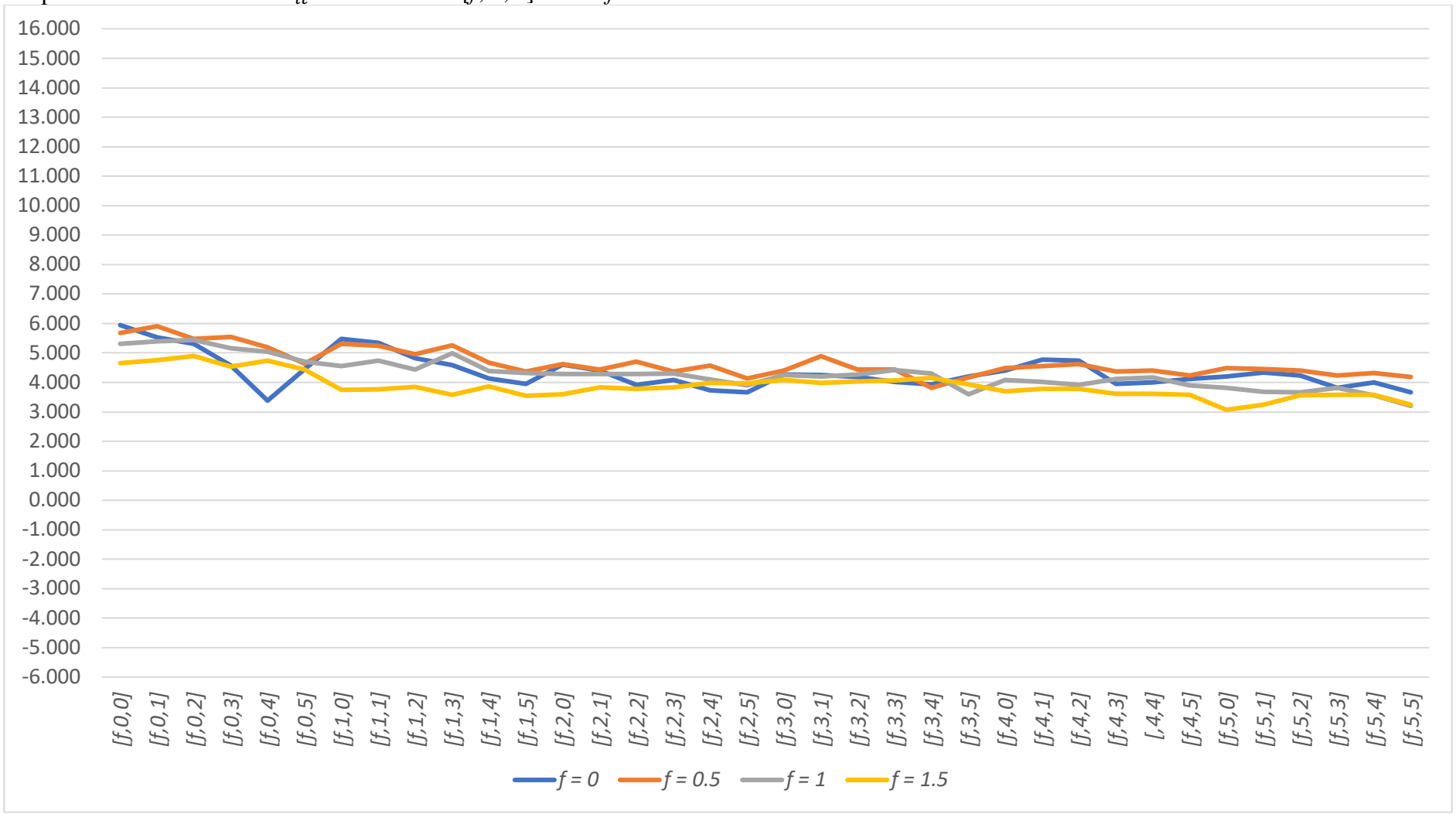
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.281*** | 6.731*** | 5.951*** | 5.568*** | 5.030*** | 5.173*** |
| 1 | 5.249*** | 5.240*** | 5.154*** | 5.433*** | 4.799*** | 4.799*** |
| 2 | 4.862*** | 4.828*** | 5.097*** | 4.917*** | 4.650*** | 4.360*** |
| 3 | 4.260*** | 4.324*** | 4.201*** | 4.176*** | 3.983*** | 3.924*** |
| 4 | 3.995*** | 3.989*** | 3.980*** | 4.098*** | 3.749*** | 3.914*** |
| 5 | 3.668** | 3.576** | 3.649** | 3.725** | 3.788*** | 3.510** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.329*** | 6.117*** | 5.803*** | 5.453*** | 5.220*** | 5.427*** |
| 1 | 4.789*** | 4.745*** | 4.654*** | 4.525*** | 4.310*** | 4.354*** |
| 2 | 4.217*** | 4.255*** | 4.323*** | 4.459*** | 4.513*** | 4.153*** |
| 3 | 3.566** | 3.468** | 3.356** | 3.457** | 3.244** | 3.137** |
| 4 | 3.070** | 2.957** | 3.201** | 3.409** | 2.998** | 2.702* |
| 5 | 3.024** | 2.700* | 2.966** | 2.608* | 2.839** | 3.027** |

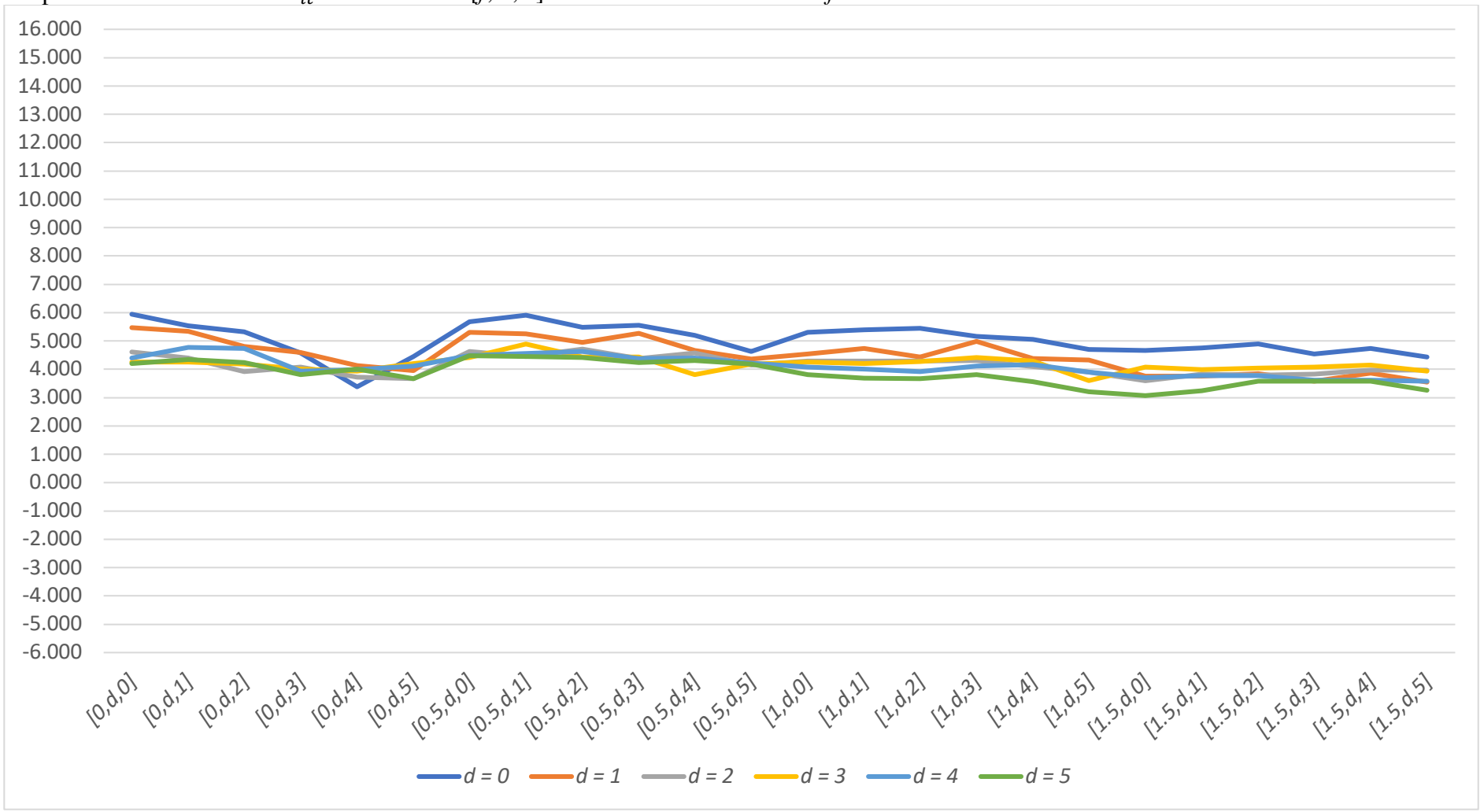
**Appendix 205: VW North America S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



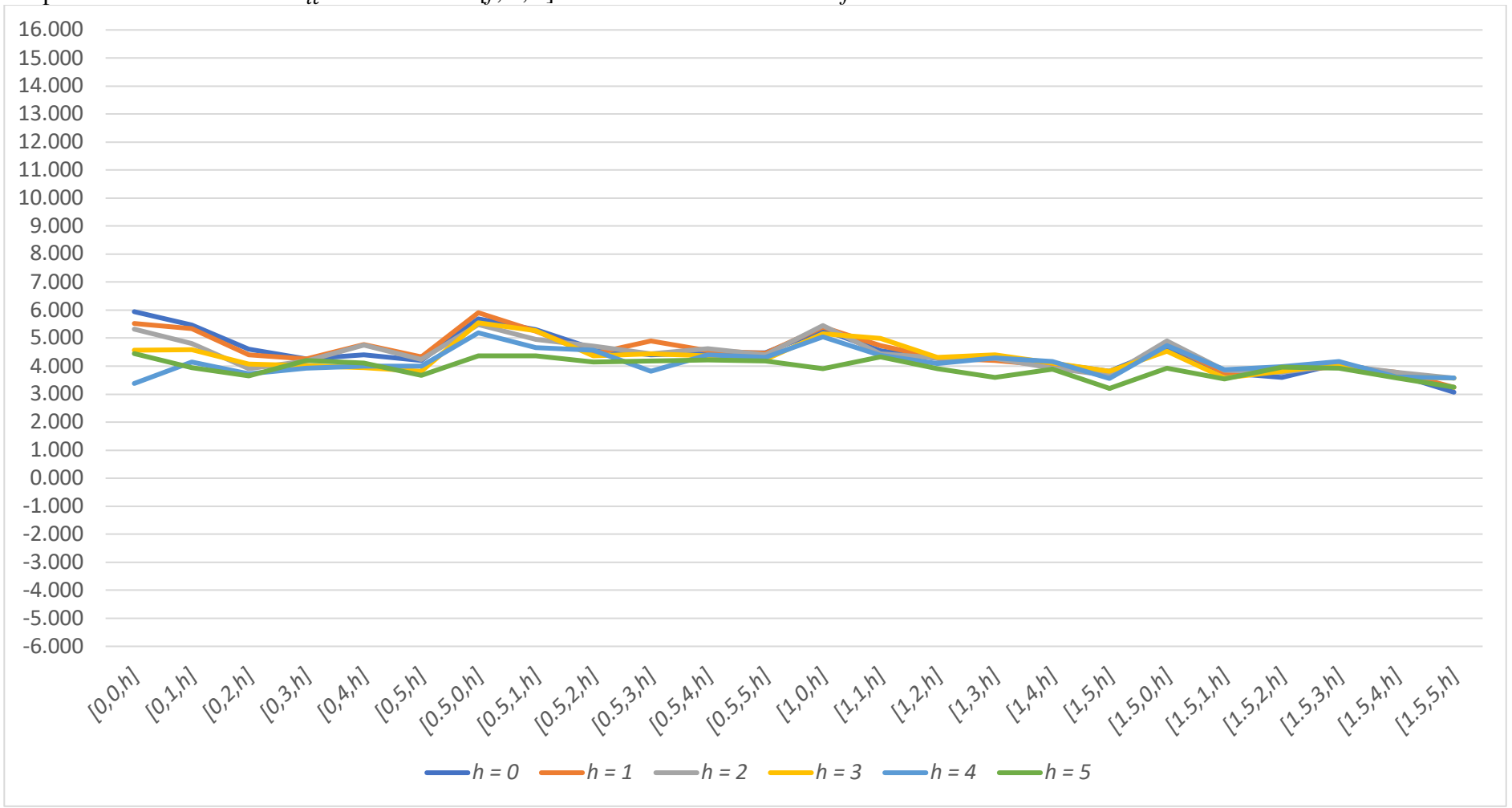
**Appendix 206: VW North America S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 207: VW North America S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 208: VW North America S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.944*** | 5.531*** | 5.315*** | 4.570*** | 3.382*** | 4.448*** |
| 1 | 5.470*** | 5.338*** | 4.815*** | 4.585*** | 4.139*** | 3.947*** |
| 2 | 4.606*** | 4.395*** | 3.915*** | 4.081*** | 3.727*** | 3.661*** |
| 3 | 4.262*** | 4.254*** | 4.185*** | 4.010*** | 3.928*** | 4.208*** |
| 4 | 4.400*** | 4.773*** | 4.744*** | 3.942*** | 3.995*** | 4.114*** |
| 5 | 4.202*** | 4.337*** | 4.230*** | 3.813*** | 4.002*** | 3.670*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.683*** | 5.907*** | 5.484*** | 5.547*** | 5.189*** | 4.636*** |
| 1 | 5.305*** | 5.248*** | 4.953*** | 5.262*** | 4.669*** | 4.363*** |
| 2 | 4.627*** | 4.443*** | 4.713*** | 4.374*** | 4.575*** | 4.141*** |
| 3 | 4.410*** | 4.892*** | 4.438*** | 4.440*** | 3.818*** | 4.176*** |
| 4 | 4.483*** | 4.555*** | 4.620*** | 4.375*** | 4.401*** | 4.228*** |
| 5 | 4.479*** | 4.452*** | 4.407*** | 4.235*** | 4.317*** | 4.186*** |

***f = 1***

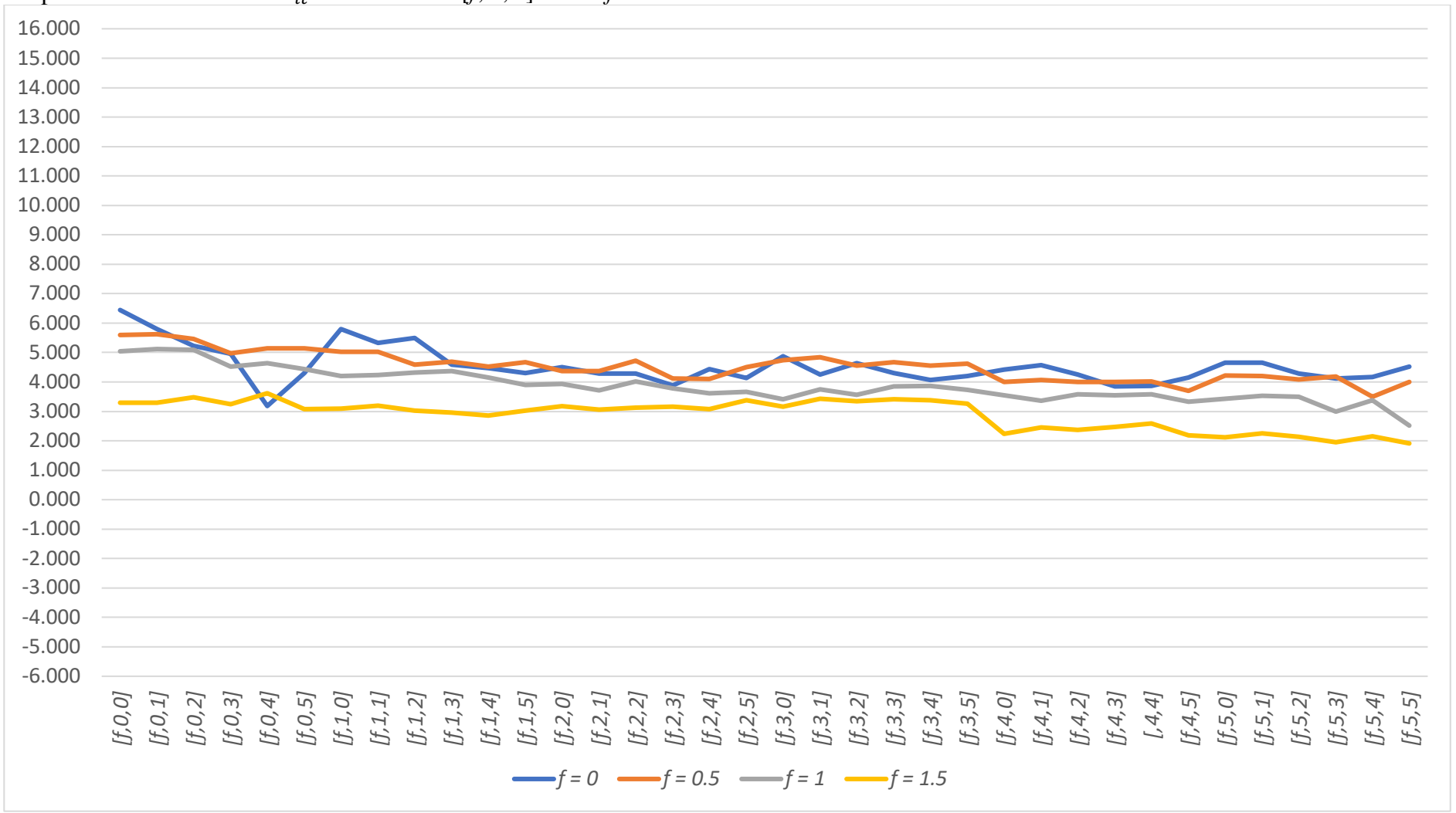
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.308*** | 5.470*** | 5.338*** | 4.815*** | 4.585*** | 4.139*** |
| 1 | 4.547*** | 4.733*** | 4.438*** | 4.988*** | 4.387*** | 4.324*** |
| 2 | 4.284*** | 4.286*** | 4.289*** | 4.303*** | 4.100*** | 3.904*** |
| 3 | 4.260*** | 4.203*** | 4.274*** | 4.412*** | 4.297*** | 3.600*** |
| 4 | 4.083*** | 4.015*** | 3.920*** | 4.119*** | 4.166*** | 3.893*** |
| 5 | 3.814*** | 3.681*** | 3.671*** | 3.810*** | 3.566*** | 3.204** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.656*** | 5.305*** | 5.248*** | 4.953*** | 5.262*** | 4.669*** |
| 1 | 3.754*** | 3.765*** | 3.847*** | 3.579*** | 3.866*** | 3.547*** |
| 2 | 3.595*** | 3.834*** | 3.787*** | 3.824*** | 3.976*** | 3.972*** |
| 3 | 4.084*** | 3.981*** | 4.040*** | 4.071*** | 4.157*** | 3.931*** |
| 4 | 3.705*** | 3.778*** | 3.784*** | 3.621*** | 3.608*** | 3.578*** |
| 5 | 3.070** | 3.245*** | 3.571*** | 3.574*** | 3.577*** | 3.252*** |

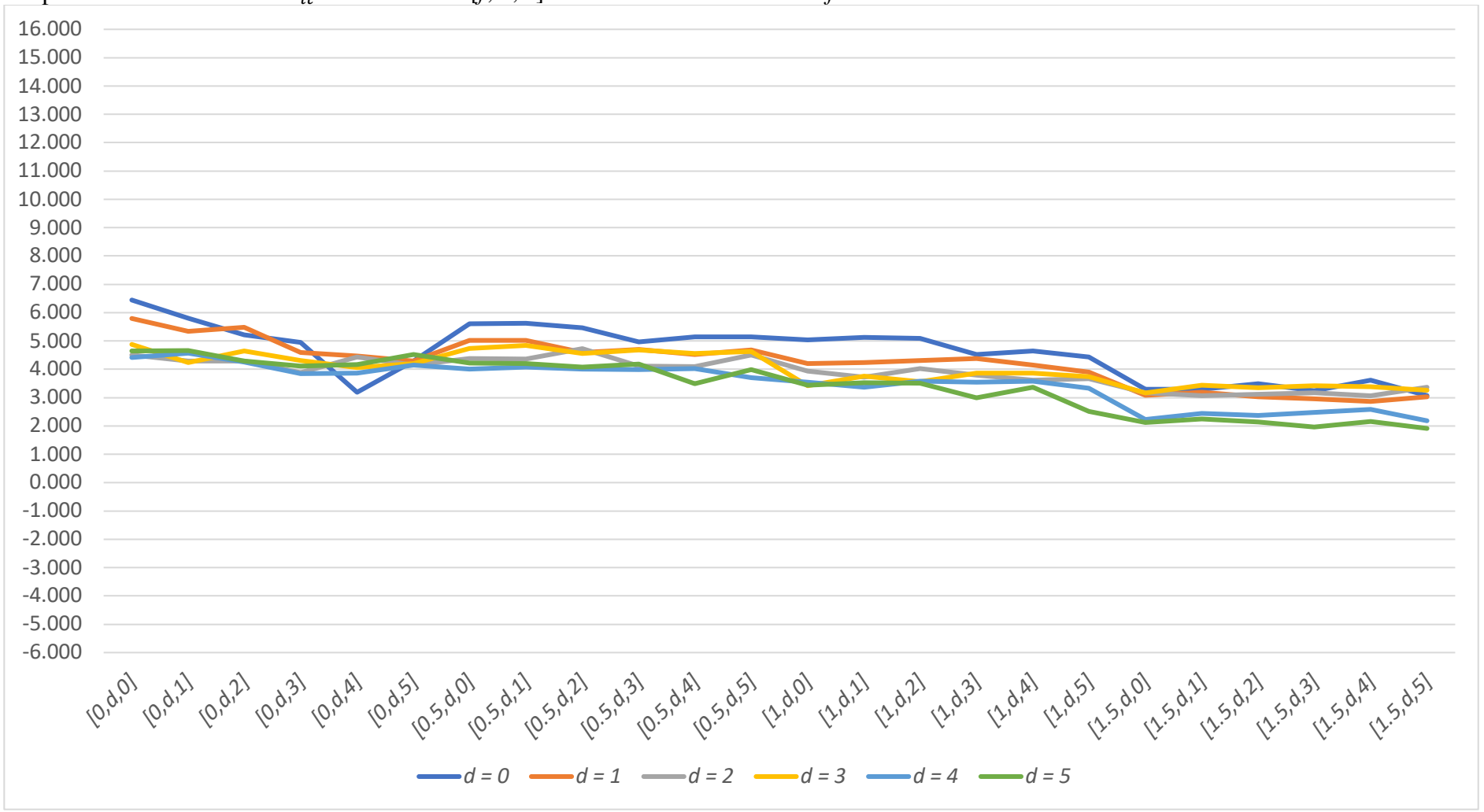
**Appendix 209: VW North America S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



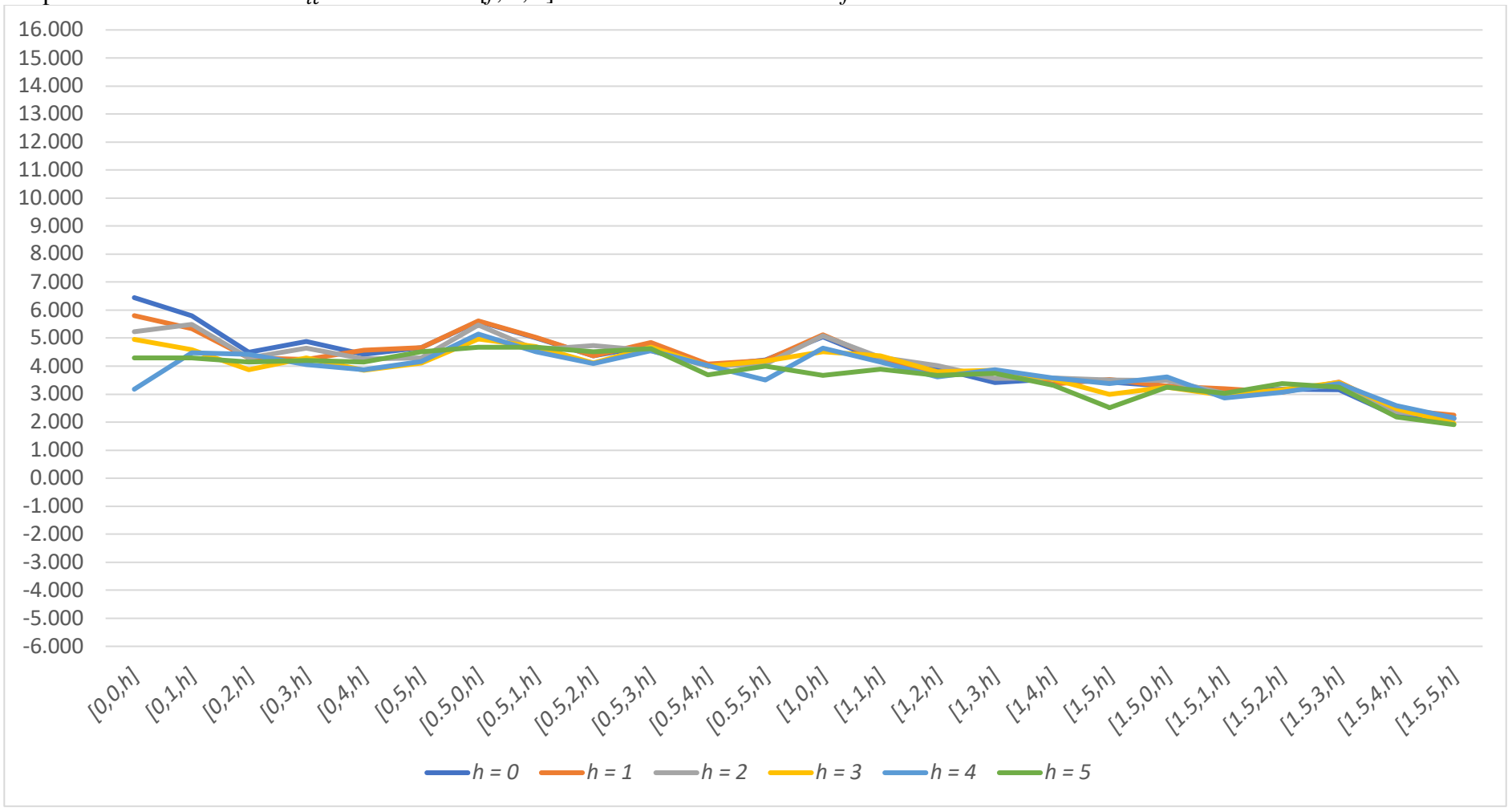
**Appendix 210: VW North America S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 211: VW North America S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 212: VW North America S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.445*** | 5.802*** | 5.221*** | 4.955*** | 3.183*** | 4.296*** |
| 1 | 5.794*** | 5.333*** | 5.490*** | 4.595*** | 4.468*** | 4.296*** |
| 2 | 4.497*** | 4.286*** | 4.285*** | 3.877*** | 4.430*** | 4.142*** |
| 3 | 4.878*** | 4.244*** | 4.640*** | 4.300*** | 4.063*** | 4.207*** |
| 4 | 4.416*** | 4.569*** | 4.249*** | 3.854*** | 3.870*** | 4.146*** |
| 5 | 4.652*** | 4.661*** | 4.294*** | 4.118*** | 4.167*** | 4.514*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.601*** | 5.622*** | 5.465*** | 4.969*** | 5.145*** | 5.150*** |
| 1 | 5.017*** | 5.027*** | 4.596*** | 4.692*** | 4.521*** | 4.675*** |
| 2 | 4.376*** | 4.369*** | 4.729*** | 4.112*** | 4.096*** | 4.505*** |
| 3 | 4.742*** | 4.848*** | 4.553*** | 4.679*** | 4.551*** | 4.621*** |
| 4 | 4.001*** | 4.070*** | 4.005*** | 3.992*** | 4.022*** | 3.696*** |
| 5 | 4.214*** | 4.199*** | 4.081*** | 4.185*** | 3.497*** | 3.996*** |

***f = 1***

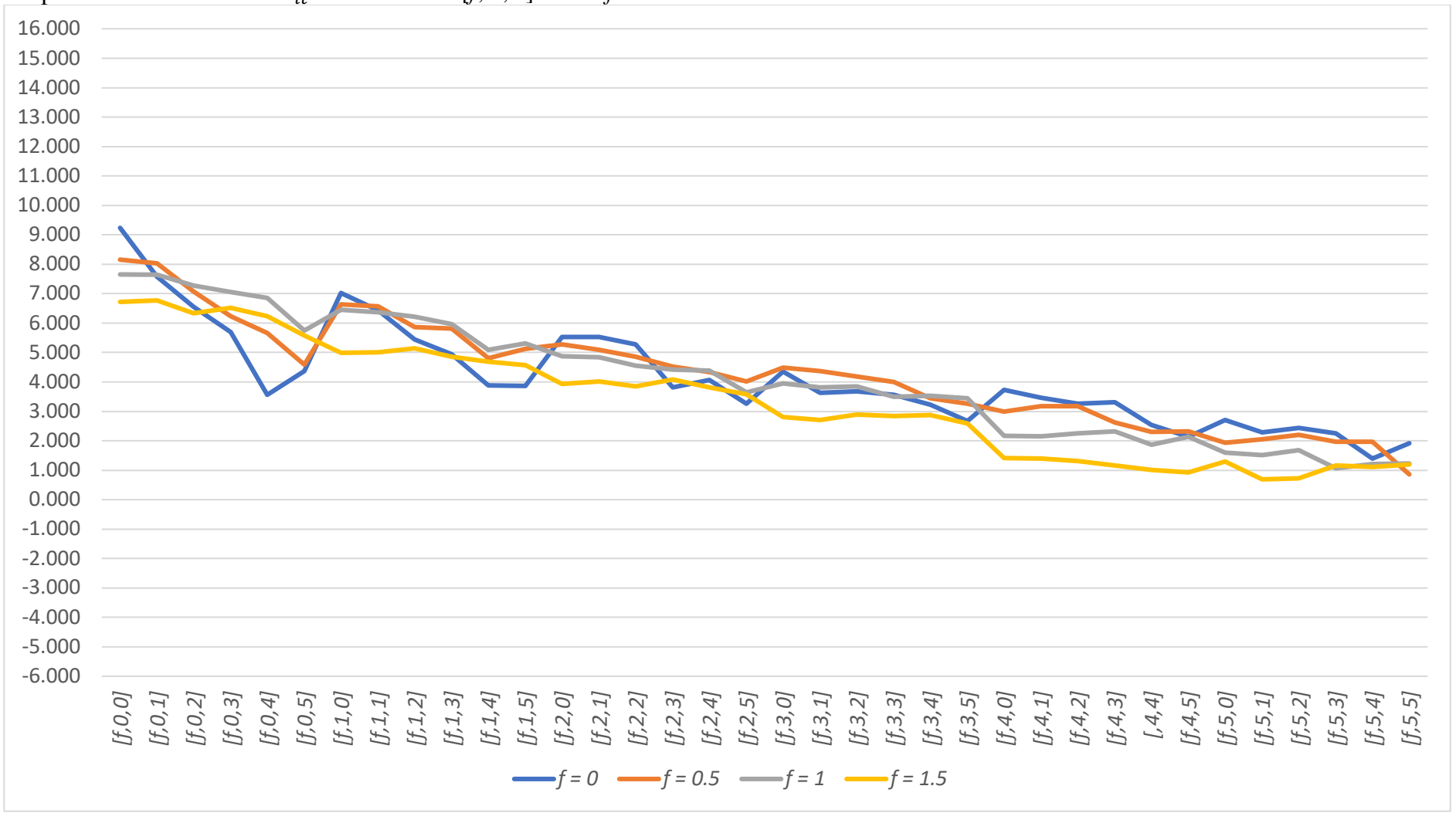
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.038*** | 5.794*** | 5.333*** | 5.490*** | 4.595*** | 4.468*** |
| 1 | 4.209*** | 4.243*** | 4.317*** | 4.374*** | 4.146*** | 3.896*** |
| 2 | 3.935*** | 3.723*** | 4.023*** | 3.790*** | 3.621*** | 3.662*** |
| 3 | 3.414*** | 3.756*** | 3.568*** | 3.857*** | 3.864*** | 3.739*** |
| 4 | 3.544*** | 3.365*** | 3.579*** | 3.542*** | 3.572*** | 3.331*** |
| 5 | 3.431*** | 3.531*** | 3.502*** | 2.988** | 3.375*** | 2.518** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.292*** | 5.017*** | 5.027*** | 4.596*** | 4.692*** | 4.521*** |
| 1 | 3.086*** | 3.191*** | 3.020** | 2.964** | 2.864** | 3.030*** |
| 2 | 3.169*** | 3.068*** | 3.120*** | 3.164*** | 3.069*** | 3.374*** |
| 3 | 3.165*** | 3.436*** | 3.340*** | 3.419*** | 3.377*** | 3.257*** |
| 4 | 2.231* | 2.449** | 2.364** | 2.475** | 2.589** | 2.183* |
| 5 | 2.123* | 2.251* | 2.133* | 1.958 | 2.153* | 1.912 |

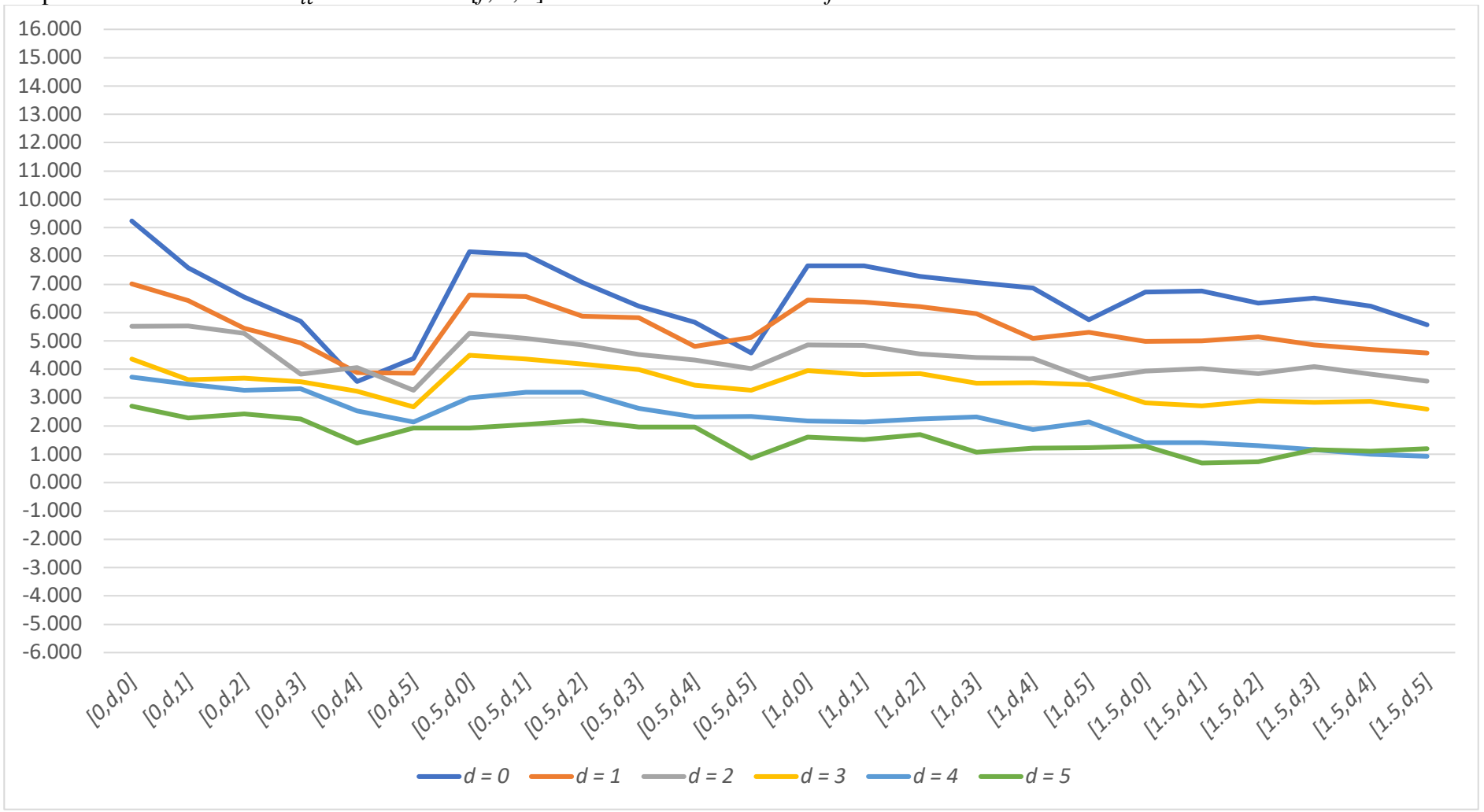
**Appendix 213: EW North America S-Low [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



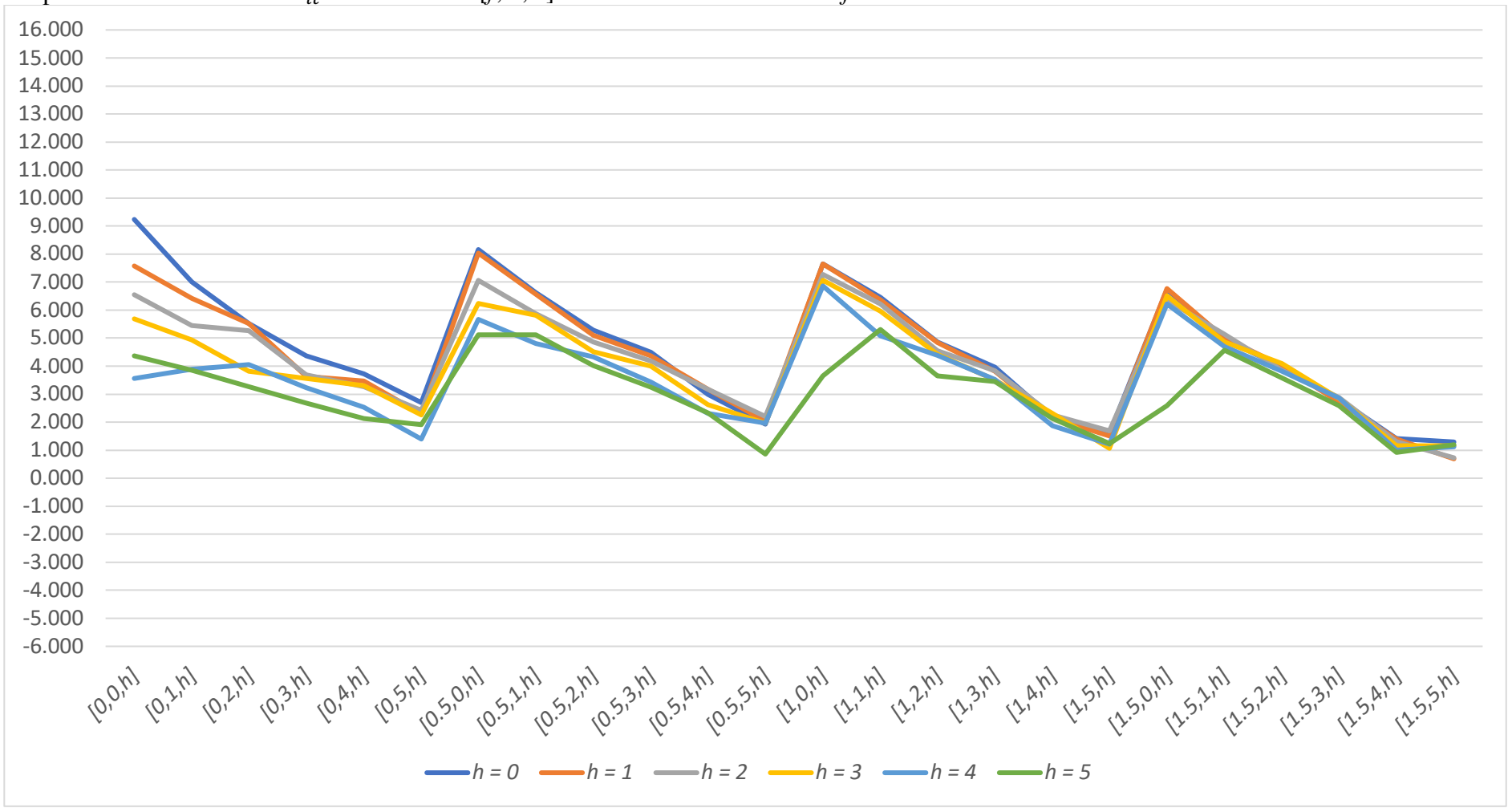
**Appendix 214: EW North America S-Low [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 215: EW North America S-Low [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 216: EW North America S-Low [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.236*** | 7.576*** | 6.555*** | 5.694*** | 3.569** | 4.374*** |
| 1 | 7.016*** | 6.429*** | 5.447*** | 4.933*** | 3.889** | 3.862** |
| 2 | 5.522*** | 5.529*** | 5.271*** | 3.822** | 4.061** | 3.259* |
| 3 | 4.359** | 3.633** | 3.688** | 3.560** | 3.232* | 2.675 |
| 4 | 3.724** | 3.468** | 3.260* | 3.308* | 2.538 | 2.133 |
| 5 | 2.699 | 2.288 | 2.433 | 2.253 | 1.396 | 1.919 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.156*** | 8.035*** | 7.069*** | 6.232*** | 5.668*** | 4.580*** |
| 1 | 6.629*** | 6.565*** | 5.869*** | 5.820*** | 4.814*** | 5.122*** |
| 2 | 5.277*** | 5.094*** | 4.860*** | 4.515** | 4.333** | 4.022** |
| 3 | 4.495** | 4.369** | 4.186** | 3.996** | 3.438* | 3.257* |
| 4 | 2.996* | 3.183* | 3.180* | 2.617 | 2.309 | 2.328 |
| 5 | 1.935 | 2.046 | 2.198 | 1.965 | 1.964 | 0.860 |

***f = 1***

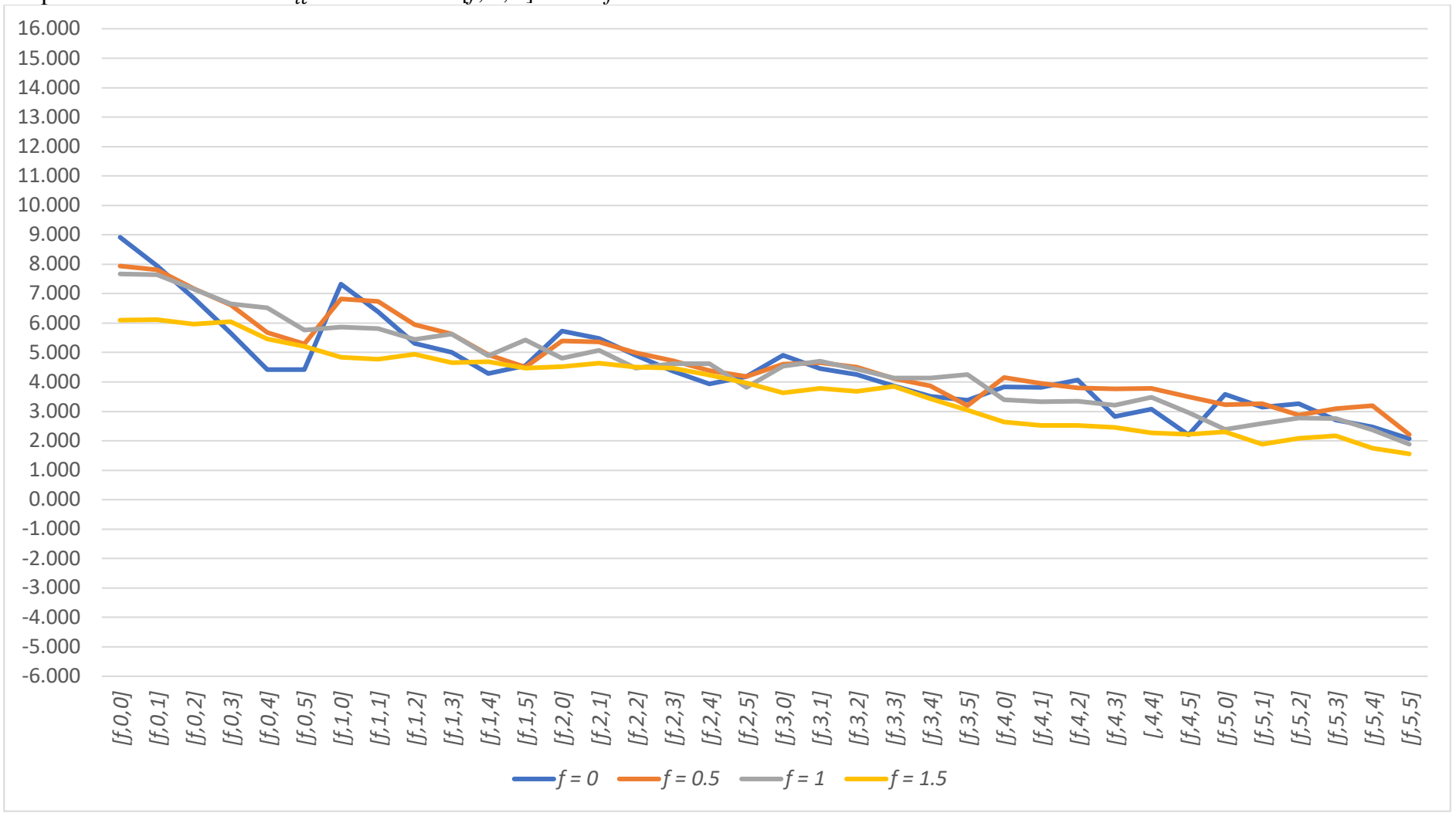
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.653*** | 7.016*** | 6.429*** | 5.447*** | 4.933*** | 3.889** |
| 1 | 6.451*** | 6.368*** | 6.218*** | 5.962*** | 5.088*** | 5.308*** |
| 2 | 4.868*** | 4.843*** | 4.548*** | 4.417** | 4.385** | 3.644** |
| 3 | 3.957** | 3.811** | 3.842** | 3.502** | 3.525** | 3.453* |
| 4 | 2.168 | 2.146 | 2.253 | 2.319 | 1.873 | 2.136 |
| 5 | 1.604 | 1.511 | 1.691 | 1.066 | 1.218 | 1.235 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.728*** | 6.629*** | 6.565*** | 5.869*** | 5.820*** | 4.814*** |
| 1 | 4.986*** | 5.011*** | 5.138*** | 4.858*** | 4.693*** | 4.574*** |
| 2 | 3.938** | 4.018** | 3.852** | 4.087** | 3.823** | 3.587** |
| 3 | 2.810 | 2.709 | 2.887 | 2.837 | 2.867 | 2.593 |
| 4 | 1.416 | 1.404 | 1.305 | 1.166 | 1.003 | 0.928 |
| 5 | 1.294 | 0.691 | 0.729 | 1.167 | 1.117 | 1.200 |

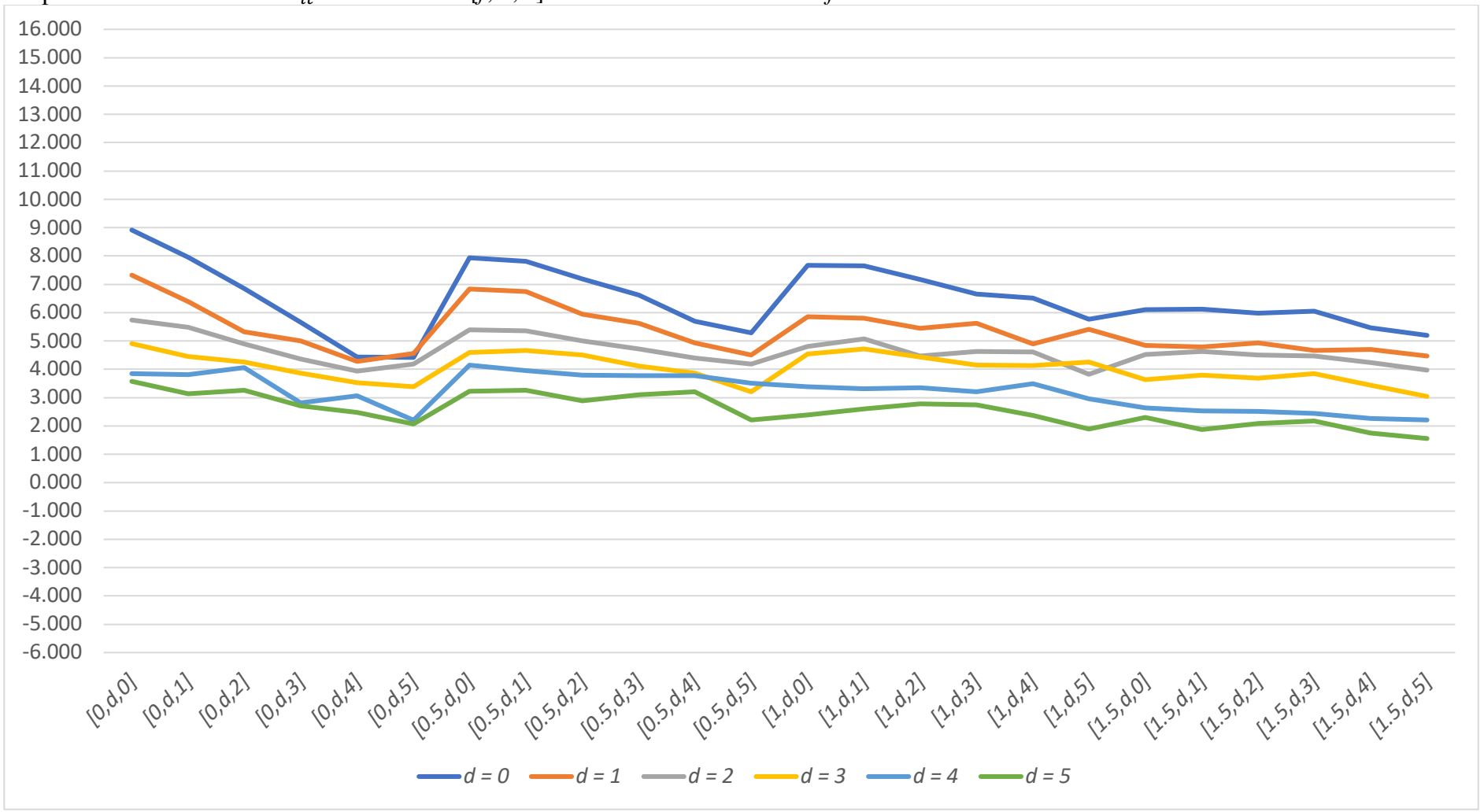
**Appendix 217: EW North America S-2 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



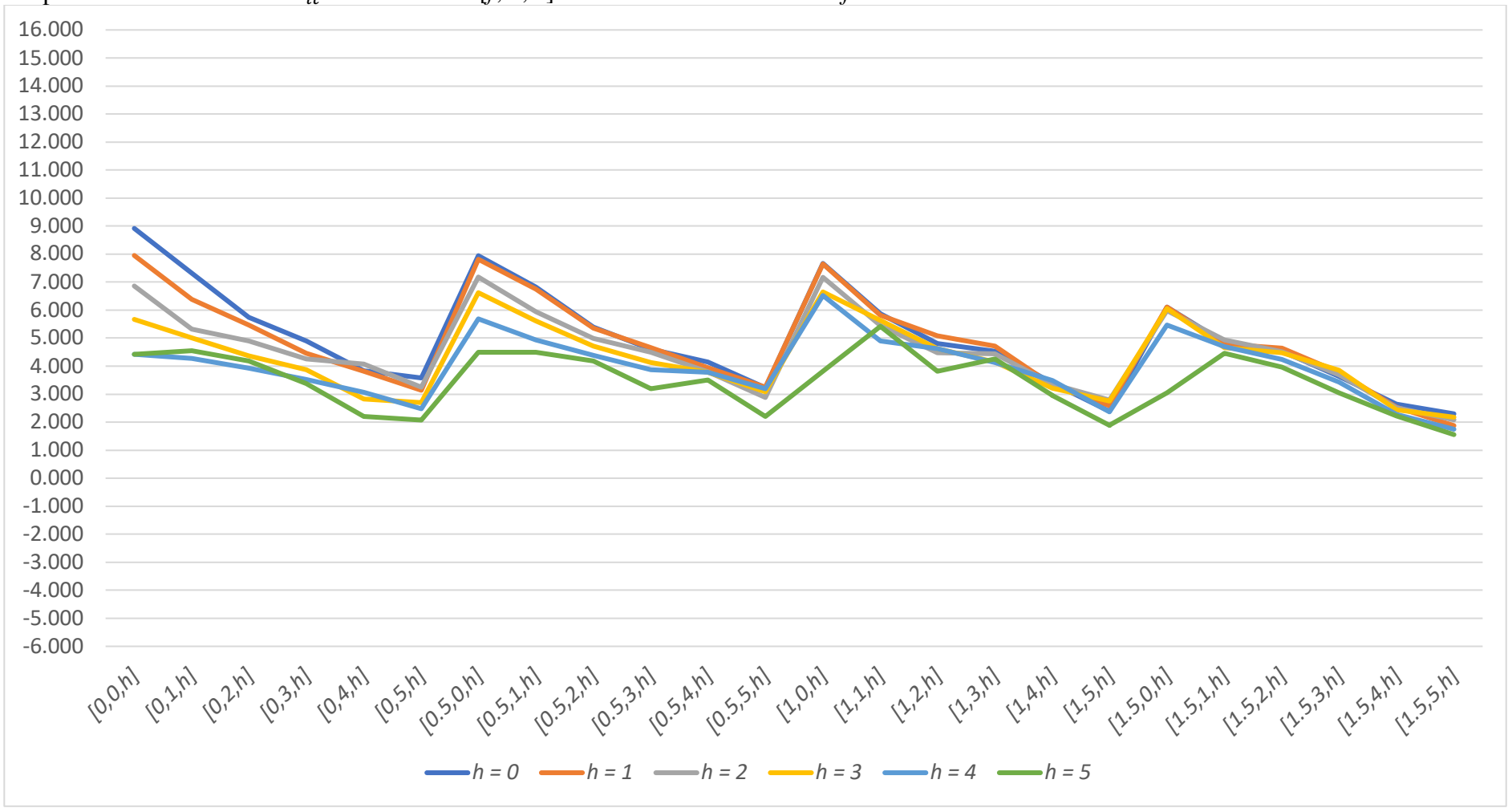
**Appendix 218: EW North America S-2 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 219: EW North America S-2 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 220: EW North America S-2 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.916*** | 7.950*** | 6.857*** | 5.663*** | 4.427*** | 4.418*** |
| 1 | 7.324*** | 6.389*** | 5.315*** | 5.003*** | 4.278*** | 4.557*** |
| 2 | 5.738*** | 5.476*** | 4.899*** | 4.365*** | 3.931** | 4.178*** |
| 3 | 4.906*** | 4.458*** | 4.259*** | 3.869** | 3.518** | 3.383** |
| 4 | 3.838** | 3.816** | 4.067** | 2.819* | 3.072* | 2.204 |
| 5 | 3.574** | 3.140* | 3.257* | 2.708 | 2.470 | 2.071 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.939*** | 7.819*** | 7.181*** | 6.614*** | 5.687*** | 5.288*** |
| 1 | 6.827*** | 6.742*** | 5.951*** | 5.622*** | 4.928*** | 4.499*** |
| 2 | 5.401*** | 5.359*** | 4.997*** | 4.719*** | 4.389*** | 4.180** |
| 3 | 4.599*** | 4.658*** | 4.504*** | 4.121** | 3.864** | 3.202** |
| 4 | 4.146** | 3.954** | 3.800** | 3.772** | 3.778** | 3.502** |
| 5 | 3.222* | 3.256* | 2.879* | 3.091* | 3.202* | 2.213 |

***f = 1***

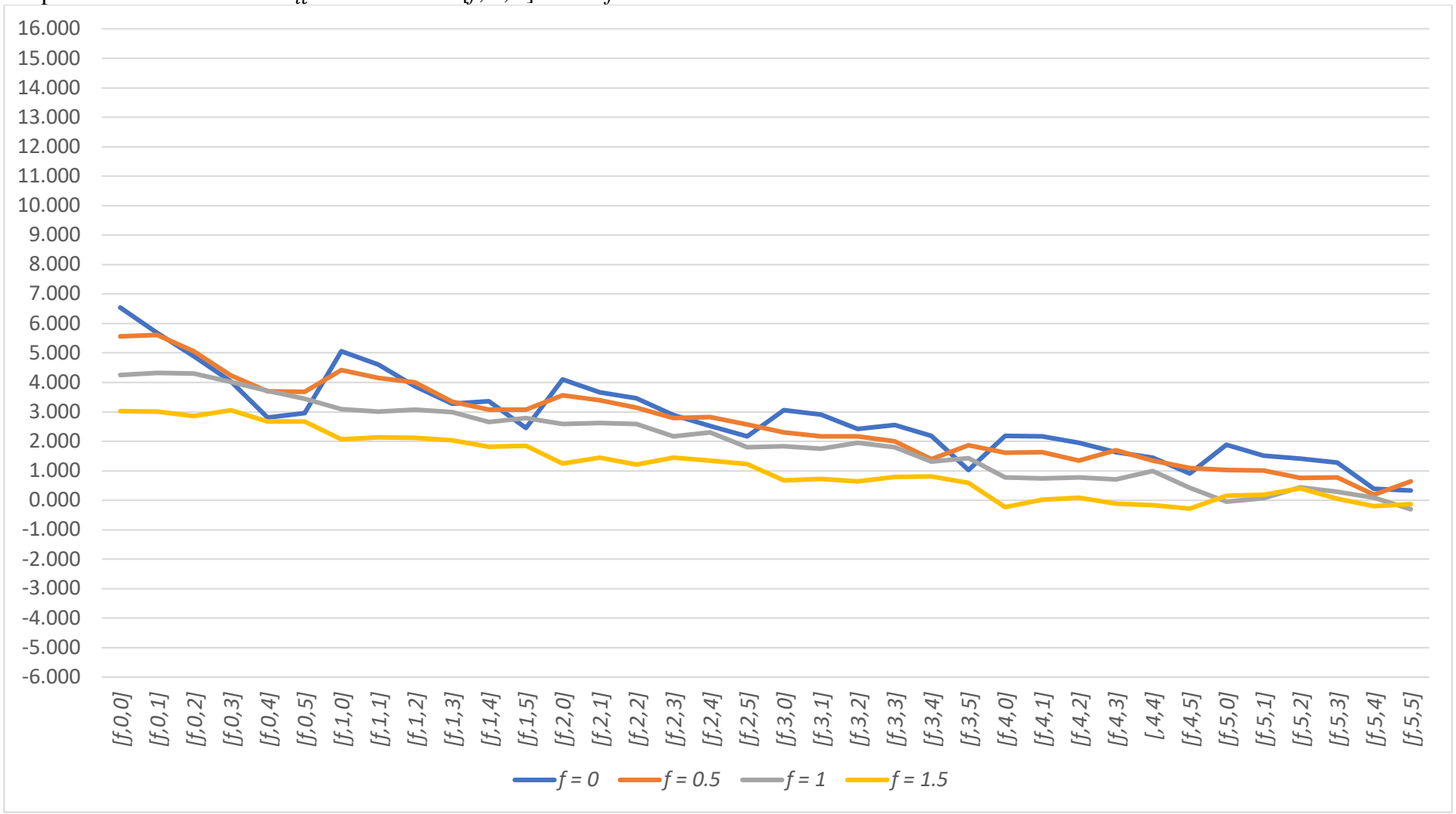
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.670*** | 7.324*** | 6.389*** | 5.315*** | 5.003*** | 4.278*** |
| 1 | 5.864*** | 5.807*** | 5.451*** | 5.625*** | 4.892*** | 5.420*** |
| 2 | 4.798*** | 5.077*** | 4.474*** | 4.629*** | 4.617*** | 3.823** |
| 3 | 4.536*** | 4.710*** | 4.437*** | 4.140** | 4.137** | 4.253** |
| 4 | 3.390** | 3.322* | 3.352* | 3.215* | 3.484** | 2.954* |
| 5 | 2.396 | 2.594 | 2.782 | 2.753 | 2.372 | 1.884 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.102*** | 6.827*** | 6.742*** | 5.951*** | 5.622*** | 4.928*** |
| 1 | 4.840*** | 4.780*** | 4.933*** | 4.662*** | 4.692*** | 4.466*** |
| 2 | 4.526*** | 4.633*** | 4.508*** | 4.475*** | 4.239** | 3.967** |
| 3 | 3.628** | 3.787** | 3.682** | 3.846** | 3.436** | 3.042* |
| 4 | 2.639 | 2.529 | 2.519 | 2.450 | 2.271 | 2.219 |
| 5 | 2.299 | 1.877 | 2.086 | 2.178 | 1.748 | 1.556 |

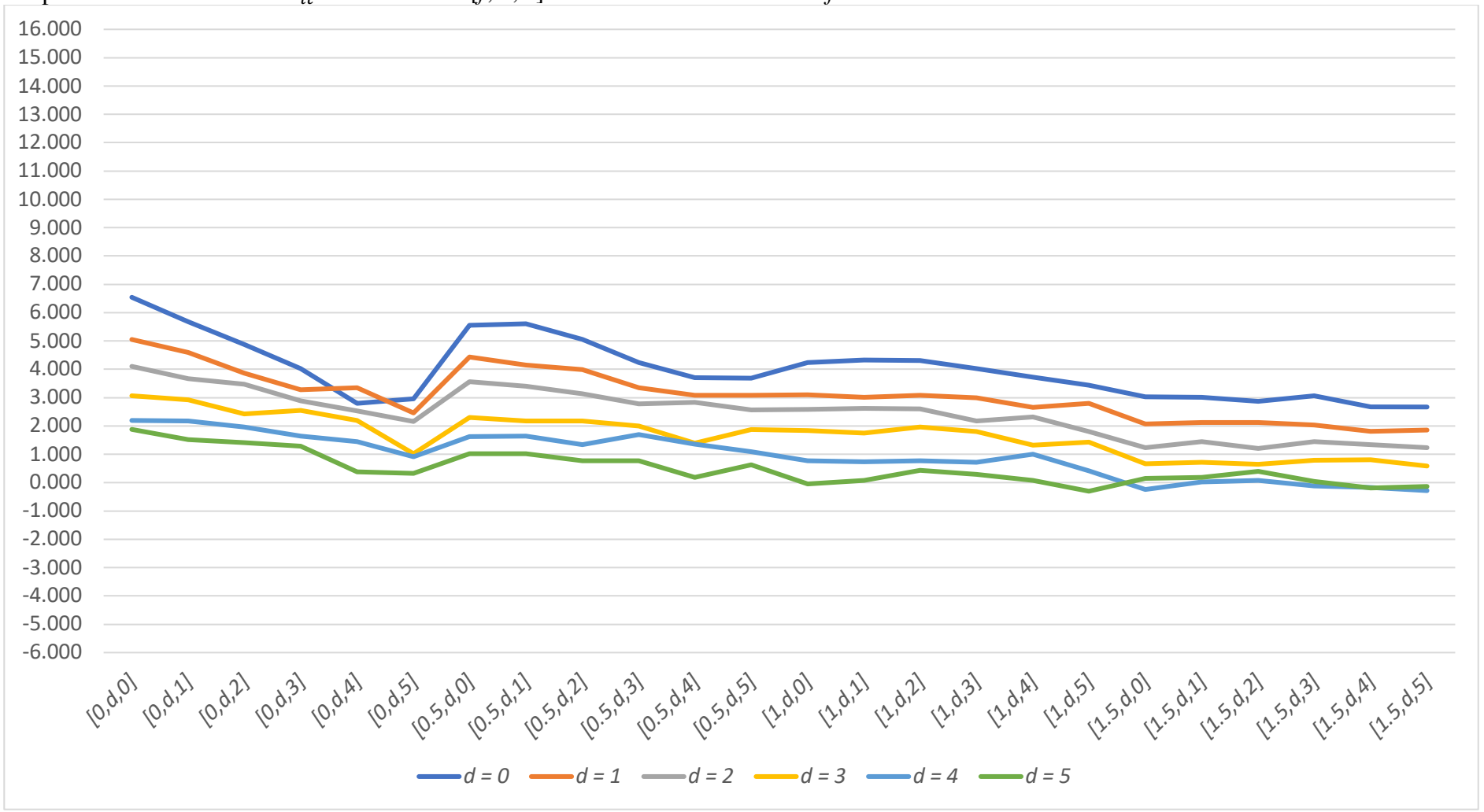
**Appendix 221: EW North America S-3 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



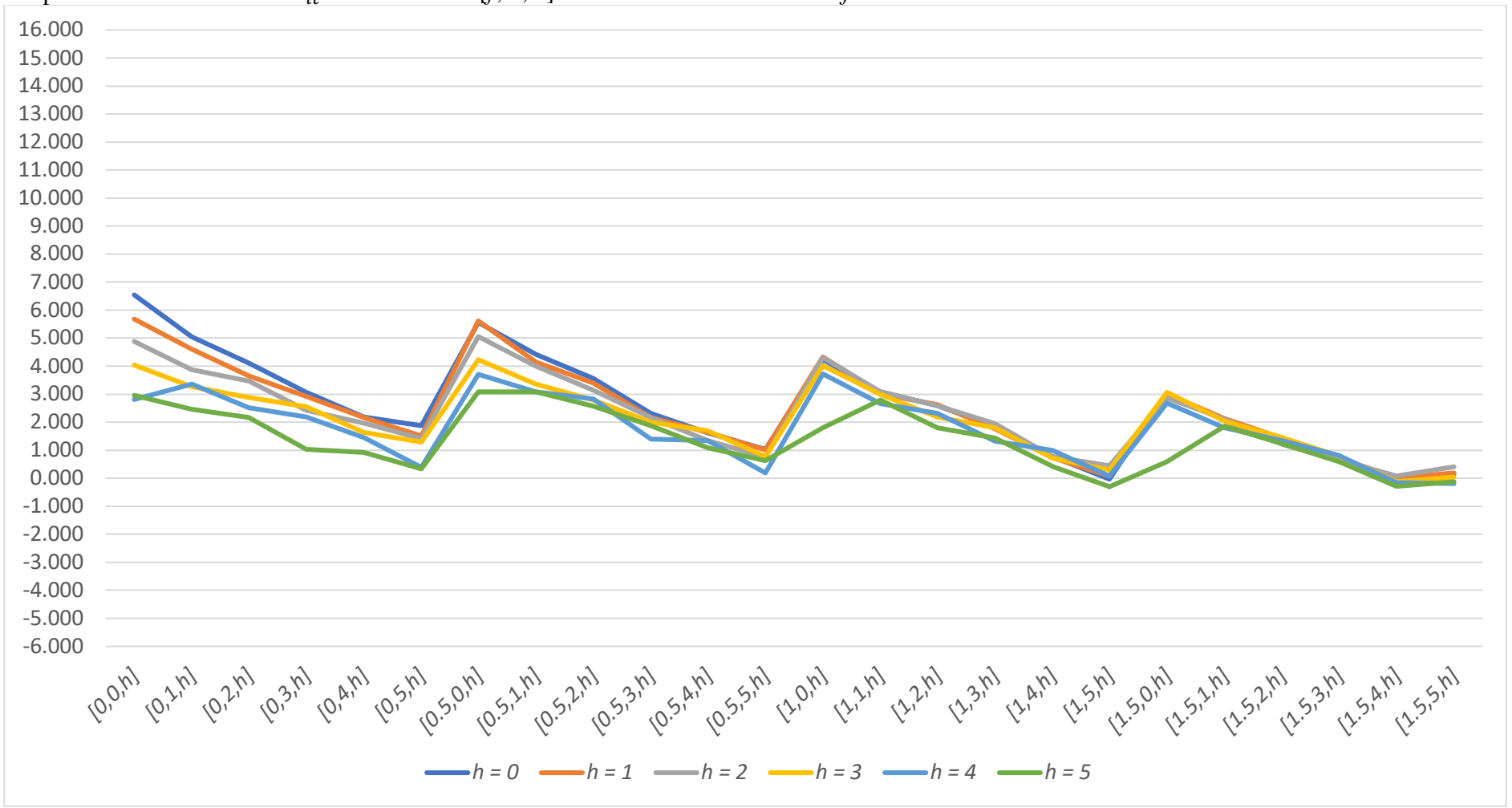
**Appendix 222: EW North America S-3 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 223: EW North America S-3 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 224: EW North America S-3 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.542*** | 5.679*** | 4.883*** | 4.030*** | 2.805** | 2.959** |
| 1 | 5.052*** | 4.600*** | 3.872*** | 3.270** | 3.357** | 2.462* |
| 2 | 4.103*** | 3.661*** | 3.466** | 2.891** | 2.522* | 2.163 |
| 3 | 3.065** | 2.917** | 2.427* | 2.556* | 2.188 | 1.028 |
| 4 | 2.194 | 2.174 | 1.959 | 1.639 | 1.452 | 0.914 |
| 5 | 1.878 | 1.516 | 1.417 | 1.283 | 0.386 | 0.332 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.559*** | 5.611*** | 5.054*** | 4.230*** | 3.704*** | 3.684*** |
| 1 | 4.427*** | 4.143*** | 3.993*** | 3.352** | 3.083** | 3.084** |
| 2 | 3.568** | 3.395** | 3.138** | 2.785* | 2.831** | 2.566* |
| 3 | 2.305 | 2.172 | 2.167 | 1.998 | 1.389 | 1.872 |
| 4 | 1.618 | 1.640 | 1.348 | 1.692 | 1.350 | 1.090 |
| 5 | 1.024 | 1.017 | 0.763 | 0.770 | 0.190 | 0.636 |

***f = 1***

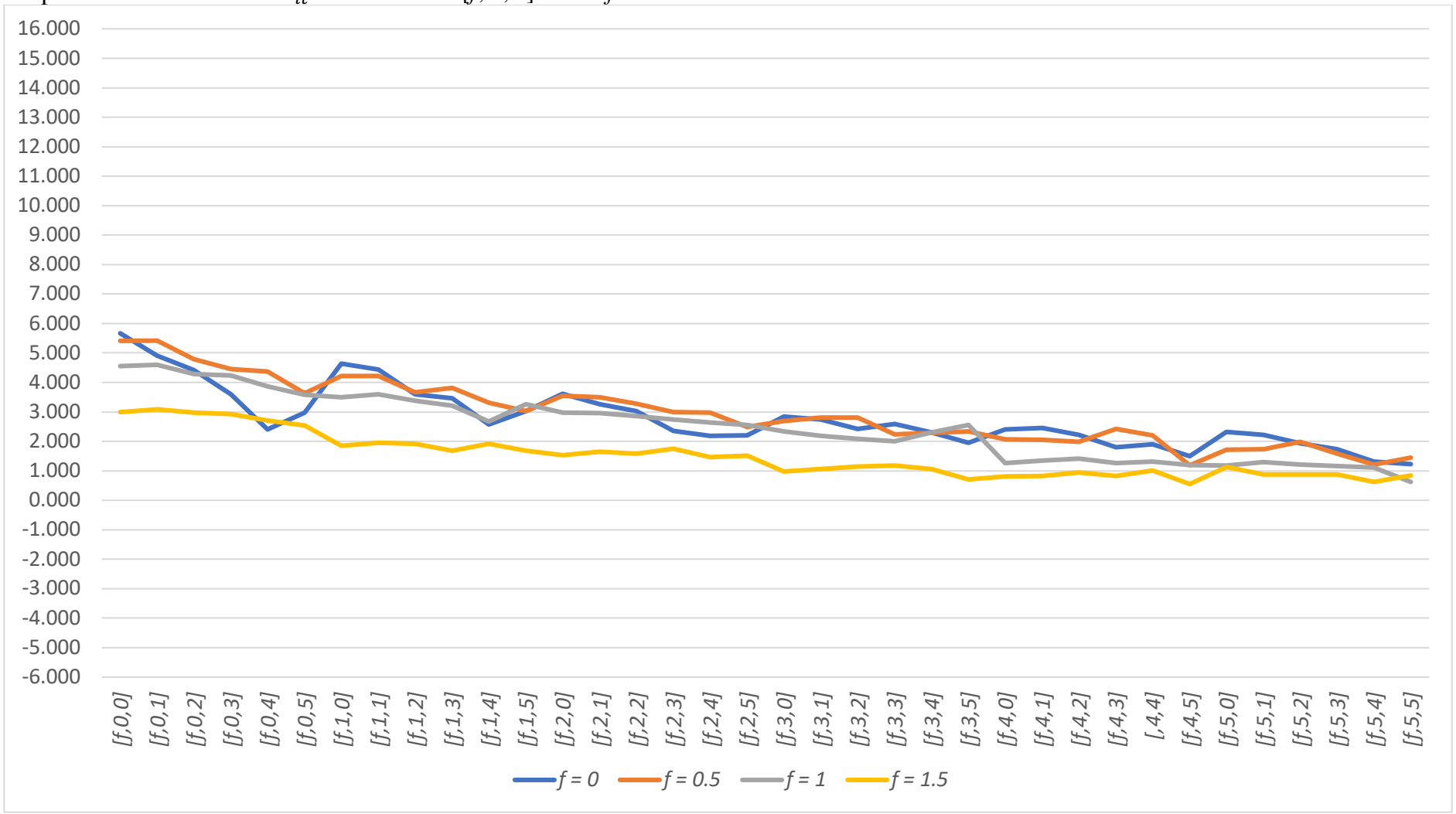
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.244*** | 5.052*** | 4.600*** | 3.872*** | 3.270** | 3.357** |
| 1 | 3.091** | 3.007** | 3.076** | 3.001** | 2.660* | 2.798** |
| 2 | 2.592* | 2.618* | 2.597* | 2.177 | 2.312 | 1.796 |
| 3 | 1.841 | 1.757 | 1.953 | 1.796 | 1.315 | 1.431 |
| 4 | 0.777 | 0.737 | 0.779 | 0.715 | 0.995 | 0.422 |
| 5 | -0.039 | 0.075 | 0.438 | 0.293 | 0.079 | -0.304 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.031** | 4.427*** | 4.143*** | 3.993*** | 3.352** | 3.083** |
| 1 | 2.062 | 2.130 | 2.116 | 2.031 | 1.809 | 1.847 |
| 2 | 1.241 | 1.440 | 1.206 | 1.450 | 1.346 | 1.226 |
| 3 | 0.668 | 0.718 | 0.647 | 0.786 | 0.803 | 0.585 |
| 4 | -0.236 | 0.017 | 0.080 | -0.122 | -0.168 | -0.283 |
| 5 | 0.151 | 0.187 | 0.402 | 0.048 | -0.190 | -0.130 |

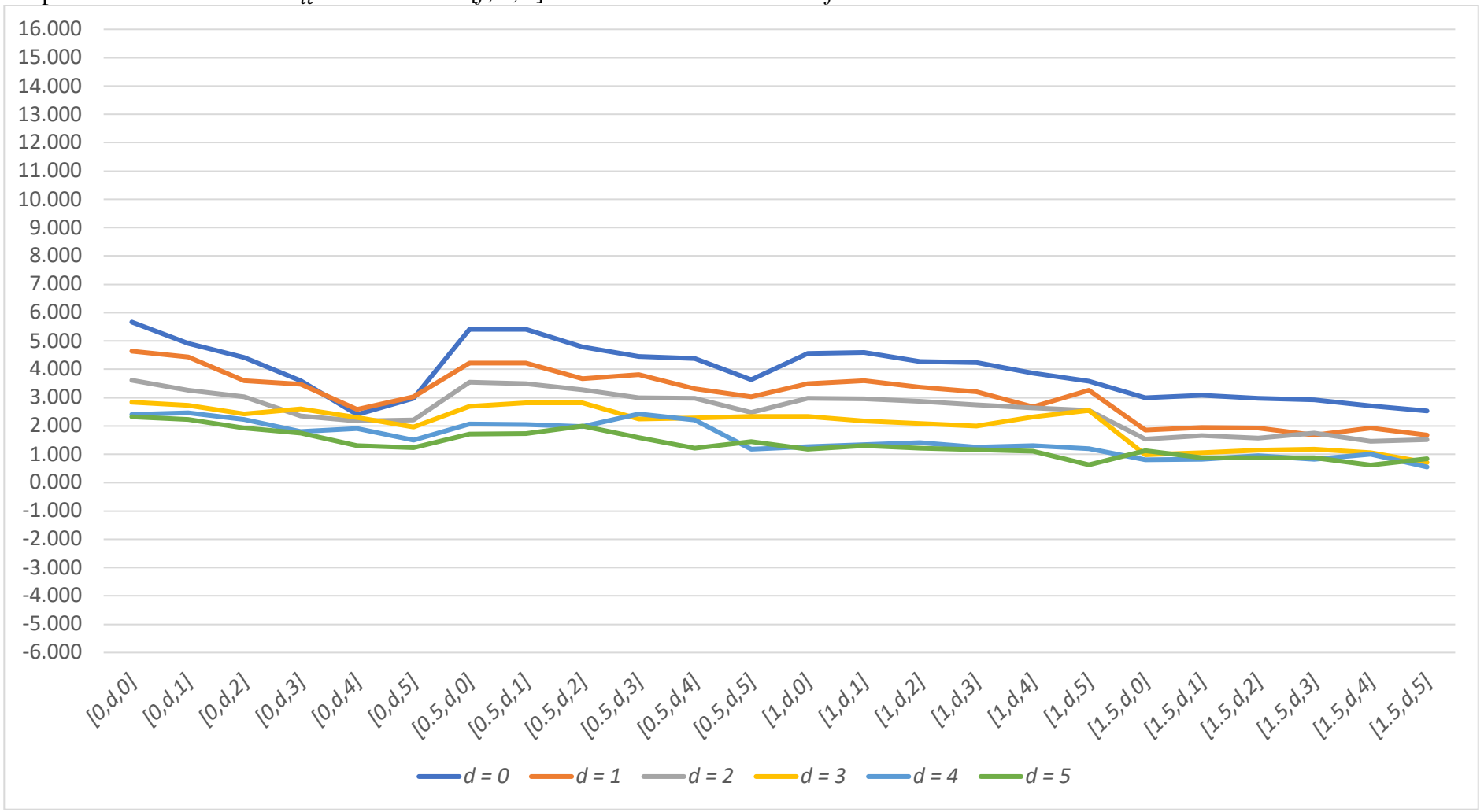
**Appendix 225: EW North America S-4 [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



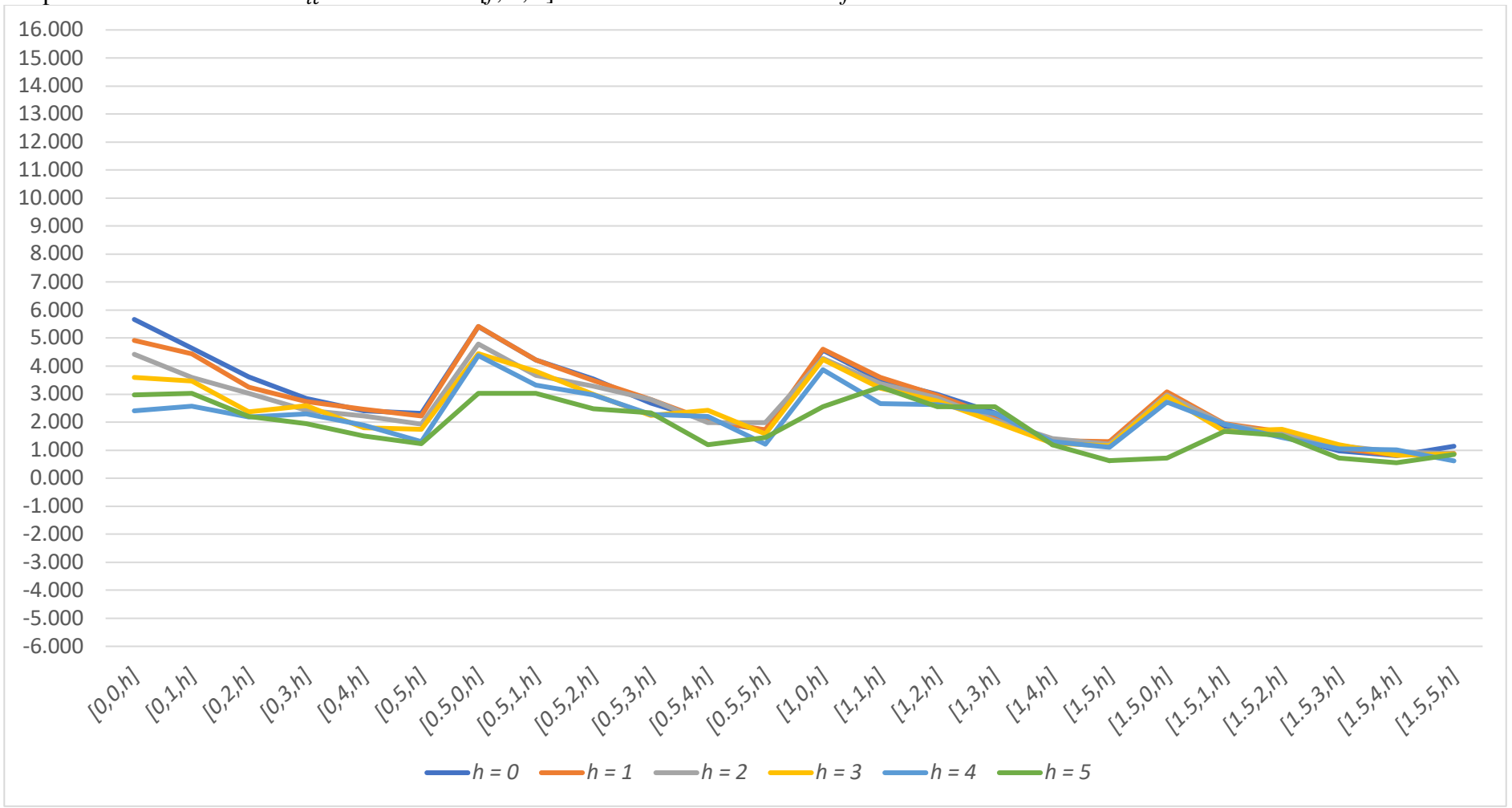
**Appendix 226: EW North America S-4 [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 227: EW North America S-4 [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 228: EW North America S-4 [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.667*** | 4.912*** | 4.415*** | 3.591*** | 2.404* | 2.982** |
| 1 | 4.639*** | 4.436*** | 3.592*** | 3.470*** | 2.579** | 3.020** |
| 2 | 3.613*** | 3.255*** | 3.021** | 2.360* | 2.184* | 2.204* |
| 3 | 2.838** | 2.735** | 2.421* | 2.594** | 2.304* | 1.956 |
| 4 | 2.407* | 2.463** | 2.224* | 1.798 | 1.900 | 1.503 |
| 5 | 2.323* | 2.223* | 1.927 | 1.741 | 1.305 | 1.227 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.407*** | 5.418*** | 4.790*** | 4.446*** | 4.376*** | 3.635*** |
| 1 | 4.219*** | 4.218*** | 3.665*** | 3.815*** | 3.314*** | 3.033** |
| 2 | 3.543*** | 3.492*** | 3.277*** | 2.991** | 2.970** | 2.485* |
| 3 | 2.683** | 2.815** | 2.811** | 2.243* | 2.283* | 2.338* |
| 4 | 2.063 | 2.059 | 1.983 | 2.425* | 2.205* | 1.187 |
| 5 | 1.709 | 1.735 | 1.990 | 1.584 | 1.219 | 1.445 |

***f = 1***

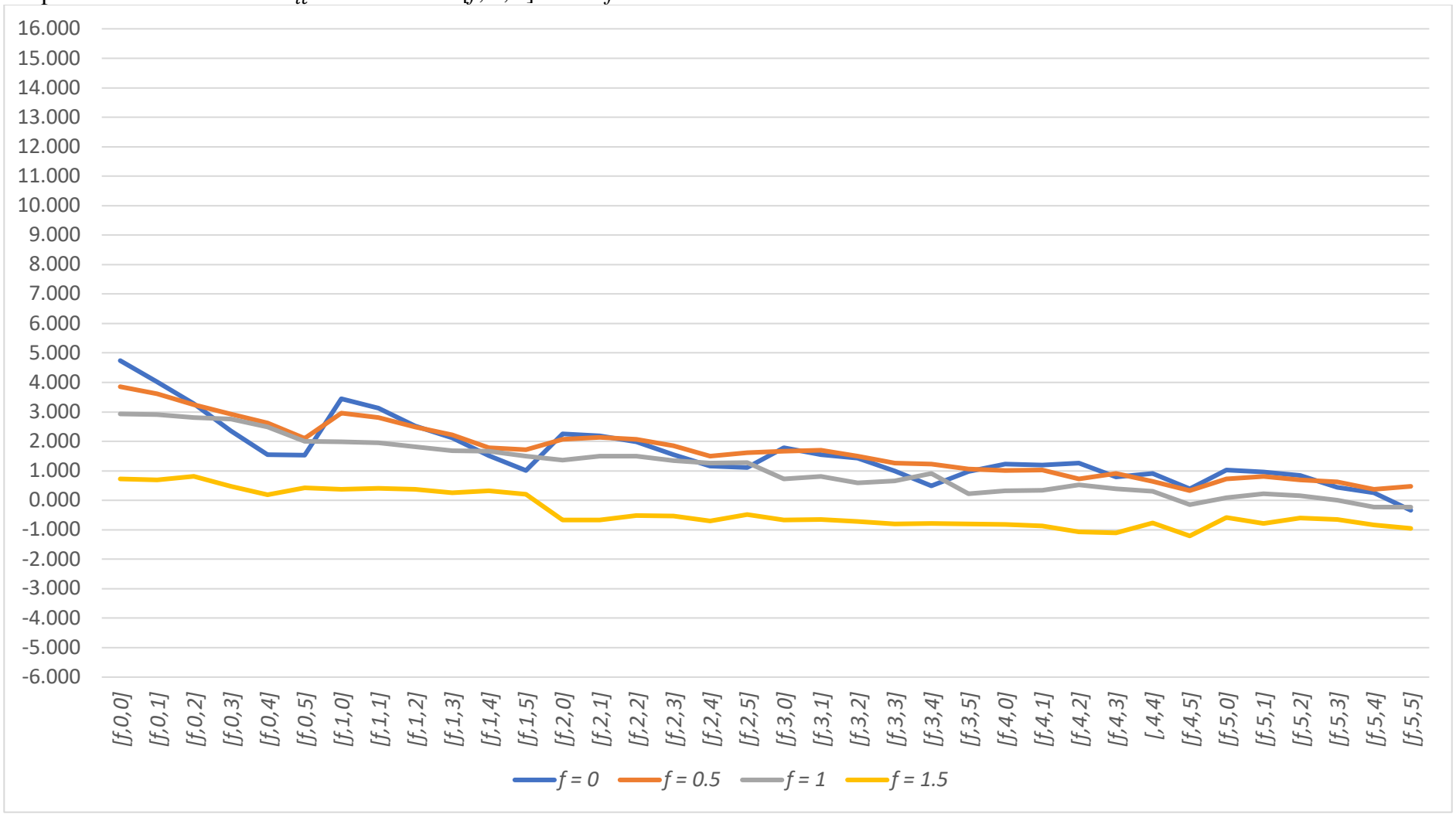
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.562*** | 4.639*** | 4.436*** | 3.592*** | 3.470*** | 2.579** |
| 1 | 3.497*** | 3.592*** | 3.371*** | 3.204** | 2.667** | 3.255*** |
| 2 | 2.984** | 2.963** | 2.861** | 2.749** | 2.633** | 2.548** |
| 3 | 2.339* | 2.179* | 2.081 | 1.996 | 2.309* | 2.551** |
| 4 | 1.271 | 1.341 | 1.409 | 1.259 | 1.311 | 1.193 |
| 5 | 1.182 | 1.297 | 1.214 | 1.163 | 1.106 | 0.622 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.994** | 4.219*** | 4.218*** | 3.665*** | 3.815*** | 3.314*** |
| 1 | 1.858 | 1.946 | 1.924 | 1.677 | 1.920 | 1.678 |
| 2 | 1.530 | 1.657 | 1.575 | 1.750 | 1.459 | 1.522 |
| 3 | 0.980 | 1.060 | 1.150 | 1.187 | 1.055 | 0.710 |
| 4 | 0.805 | 0.821 | 0.944 | 0.818 | 1.006 | 0.552 |
| 5 | 1.133 | 0.880 | 0.875 | 0.869 | 0.619 | 0.850 |

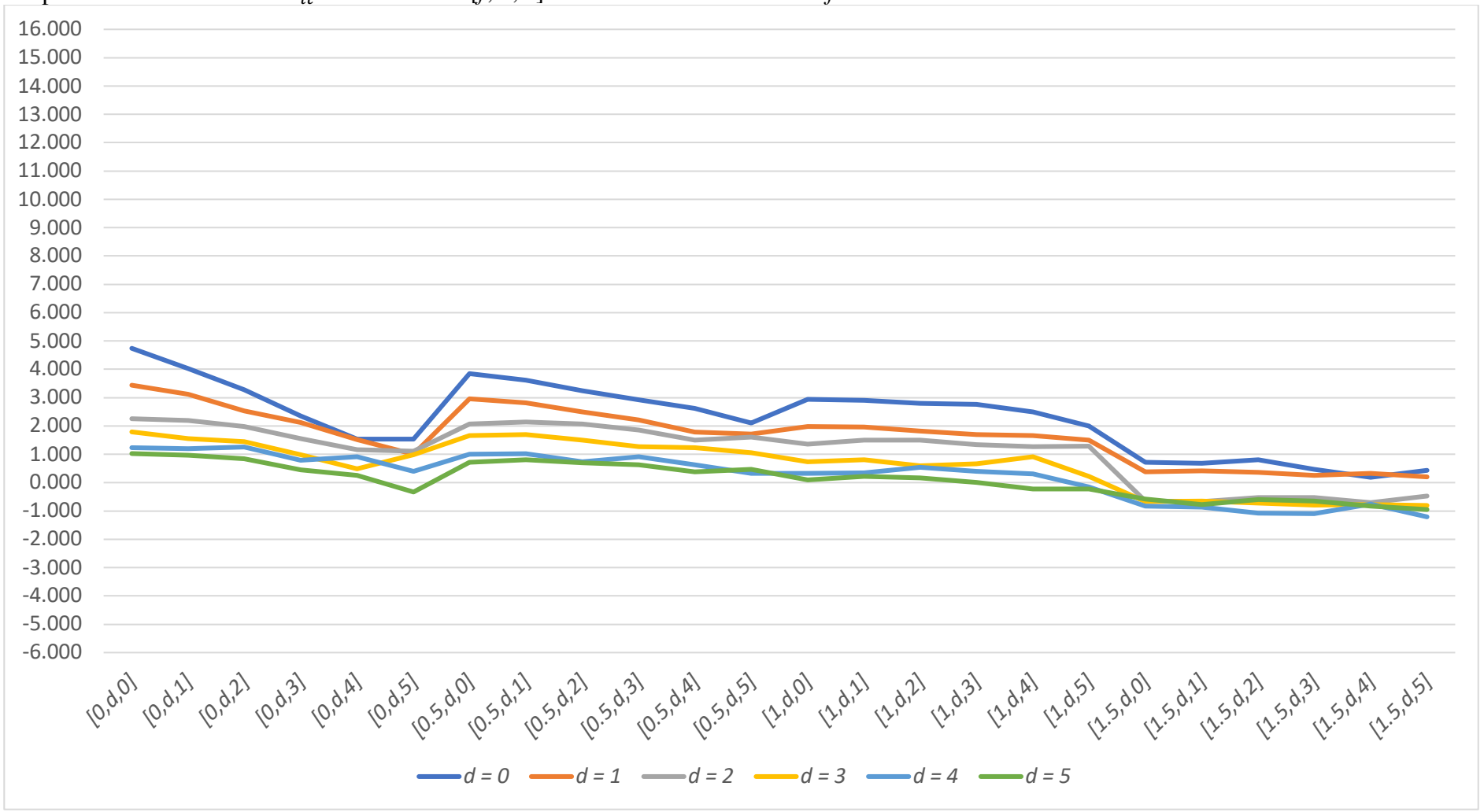
**Appendix 229: EW North America S-High [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



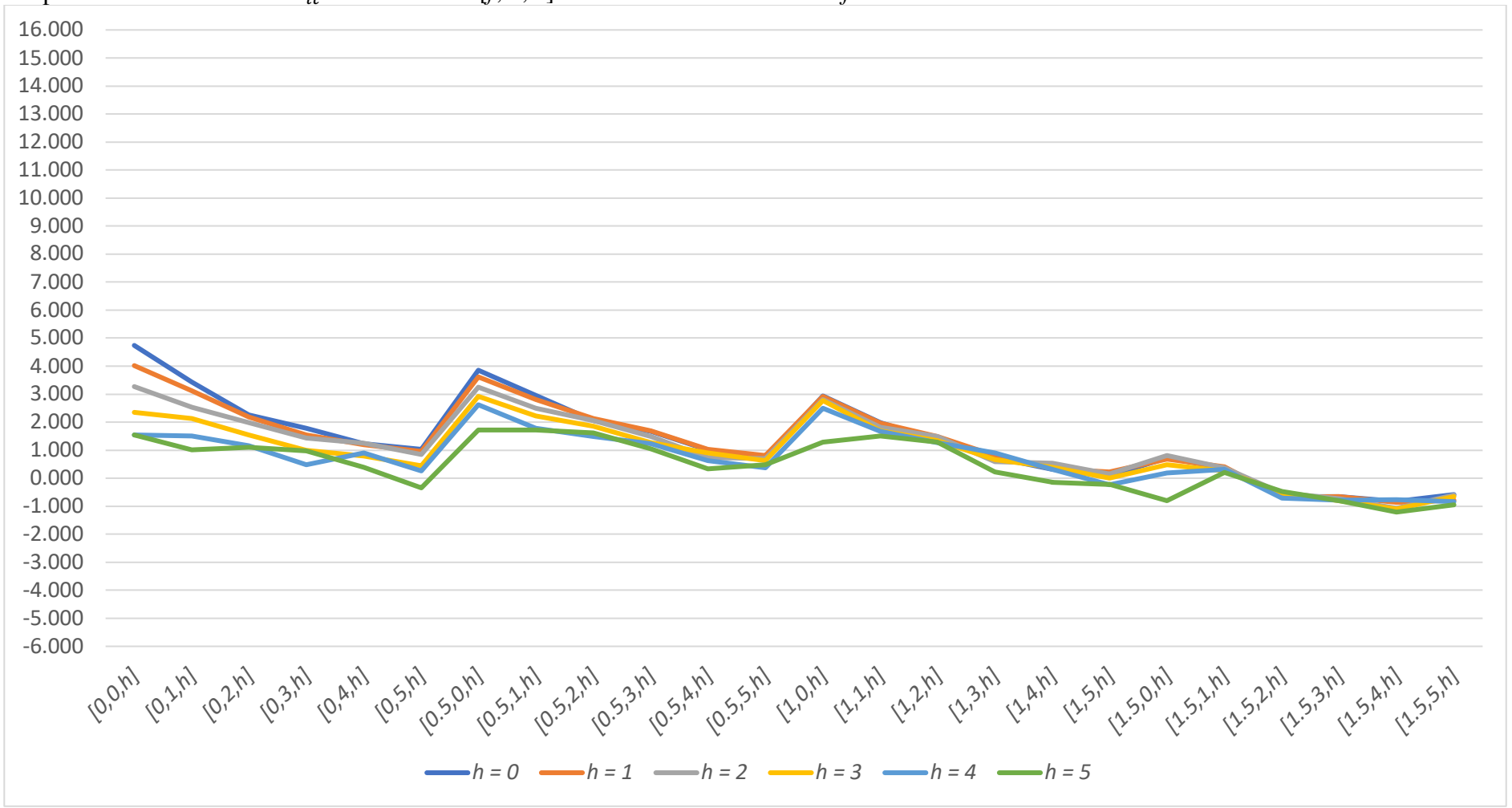
**Appendix 230: EW North America S-High [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 231: EW North America S-High [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 232: EW North America S-High [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.740*** | 4.019*** | 3.270*** | 2.354** | 1.544 | 1.535 |
| 1 | 3.438*** | 3.122*** | 2.530** | 2.125* | 1.511 | 1.010 |
| 2 | 2.255* | 2.187* | 1.981* | 1.547 | 1.157 | 1.110 |
| 3 | 1.790 | 1.550 | 1.439 | 0.990 | 0.486 | 0.976 |
| 4 | 1.226 | 1.191 | 1.257 | 0.787 | 0.911 | 0.391 |
| 5 | 1.025 | 0.959 | 0.848 | 0.443 | 0.256 | -0.339 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.855*** | 3.614*** | 3.245*** | 2.922** | 2.622** | 2.105* |
| 1 | 2.955** | 2.813** | 2.490** | 2.215* | 1.778 | 1.721 |
| 2 | 2.065* | 2.138* | 2.062* | 1.848 | 1.494 | 1.612 |
| 3 | 1.664 | 1.696 | 1.491 | 1.271 | 1.230 | 1.056 |
| 4 | 1.006 | 1.027 | 0.731 | 0.908 | 0.634 | 0.329 |
| 5 | 0.720 | 0.806 | 0.698 | 0.629 | 0.376 | 0.476 |

***f = 1***

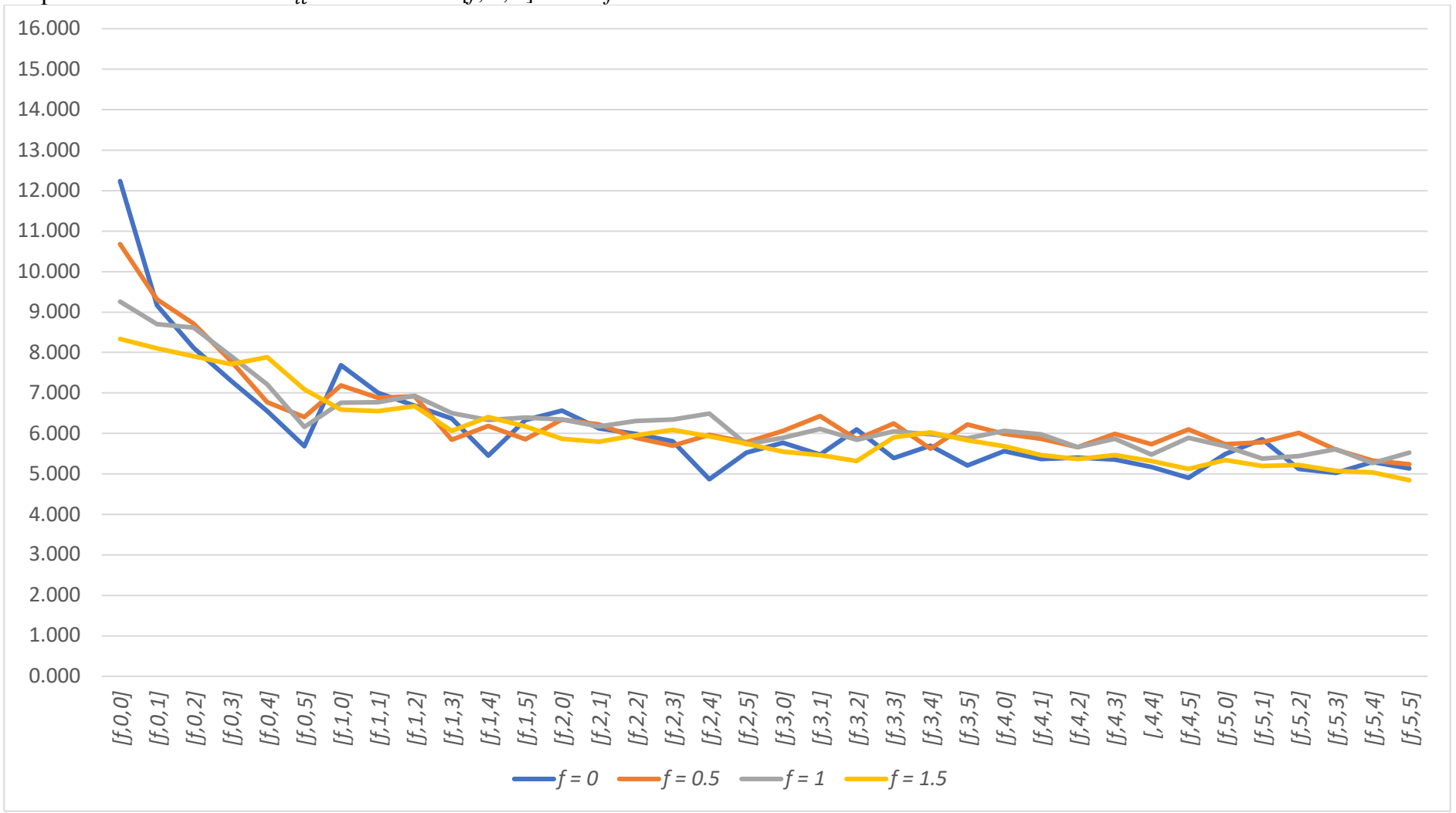
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.931** | 3.438*** | 3.122*** | 2.530** | 2.125* | 1.511 |
| 1 | 1.979* | 1.958* | 1.821 | 1.691 | 1.665 | 1.501 |
| 2 | 1.363 | 1.496 | 1.495 | 1.340 | 1.260 | 1.288 |
| 3 | 0.730 | 0.805 | 0.591 | 0.657 | 0.905 | 0.224 |
| 4 | 0.323 | 0.339 | 0.531 | 0.391 | 0.314 | -0.147 |
| 5 | 0.087 | 0.222 | 0.159 | 0.002 | -0.230 | -0.224 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0.725 | 2.955** | 2.813** | 2.490** | 2.215* | 1.778 |
| 1 | 0.378 | 0.409 | 0.365 | 0.255 | 0.324 | 0.202 |
| 2 | -0.660 | -0.674 | -0.523 | -0.535 | -0.707 | -0.478 |
| 3 | -0.661 | -0.659 | -0.722 | -0.796 | -0.784 | -0.808 |
| 4 | -0.825 | -0.862 | -1.075 | -1.098 | -0.764 | -1.209 |
| 5 | -0.580 | -0.784 | -0.601 | -0.658 | -0.836 | -0.952 |

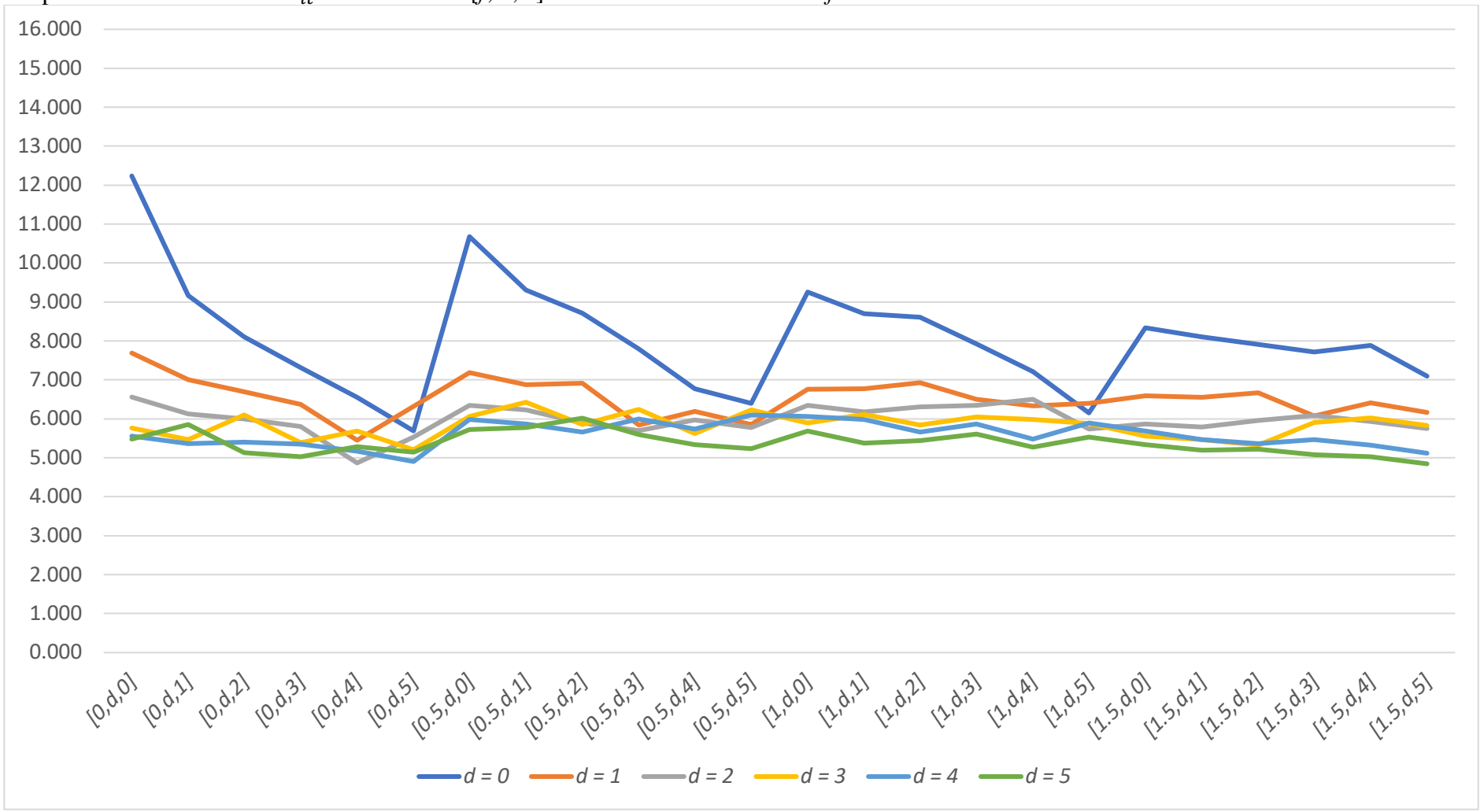
**Appendix 233: VW Health [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



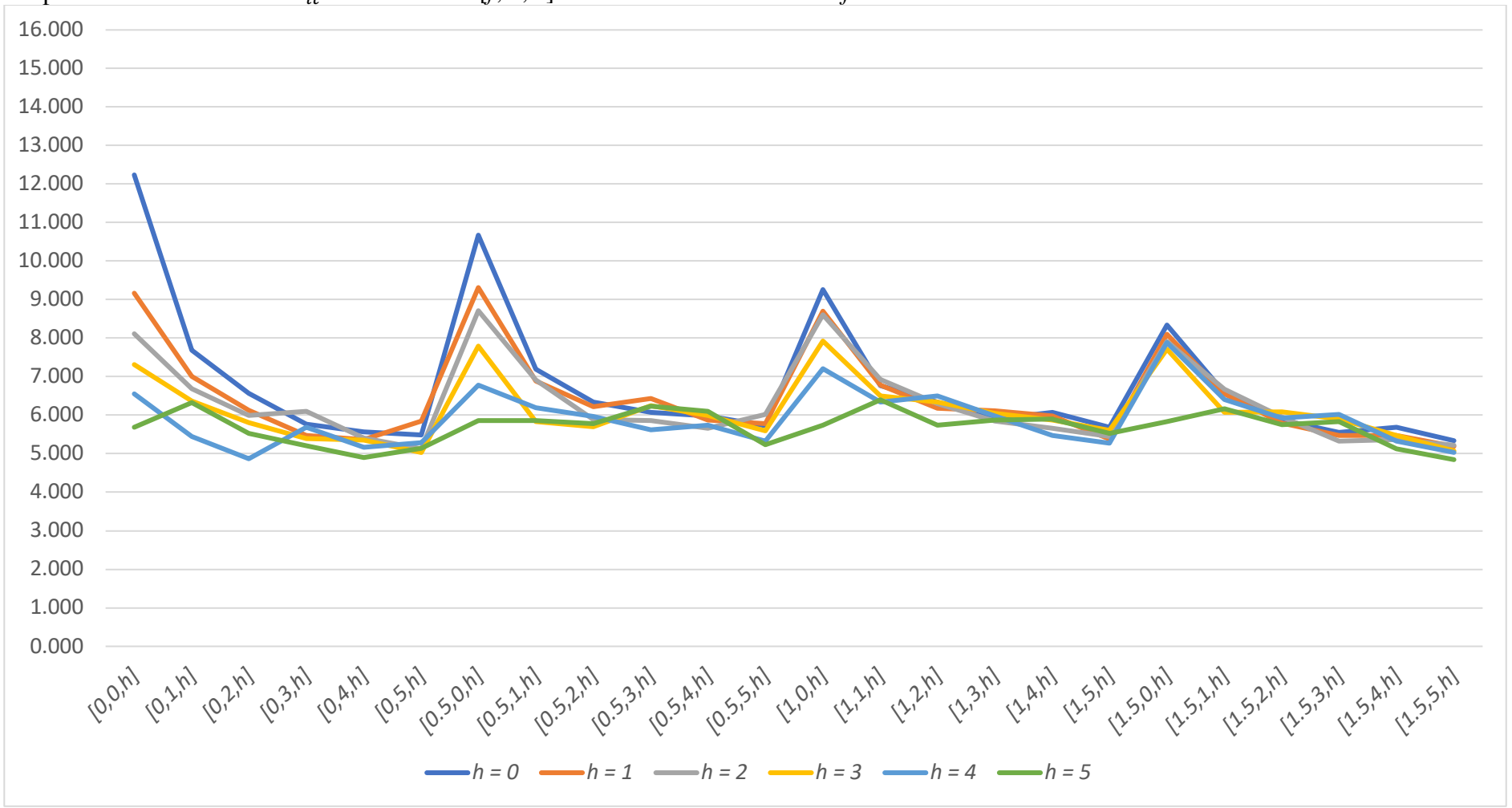
**Appendix 234: VW Health [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 235: VW Health [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 236: VW Health [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.236*** | 9.171*** | 8.110*** | 7.314*** | 6.549*** | 5.691*** |
| 1 | 7.690*** | 7.001*** | 6.692*** | 6.366*** | 5.451*** | 6.327*** |
| 2 | 6.560*** | 6.128*** | 5.991*** | 5.806*** | 4.869** | 5.526*** |
| 3 | 5.766*** | 5.473*** | 6.103*** | 5.394*** | 5.692*** | 5.207** |
| 4 | 5.562*** | 5.365*** | 5.405*** | 5.351** | 5.168** | 4.905** |
| 5 | 5.484*** | 5.851*** | 5.128** | 5.031** | 5.290** | 5.140** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.678*** | 9.312*** | 8.712*** | 7.795*** | 6.775*** | 6.402*** |
| 1 | 7.189*** | 6.881*** | 6.917*** | 5.838*** | 6.191*** | 5.855*** |
| 2 | 6.344*** | 6.224*** | 5.892*** | 5.701*** | 5.966*** | 5.783*** |
| 3 | 6.067*** | 6.427*** | 5.854*** | 6.243*** | 5.621*** | 6.227*** |
| 4 | 5.985*** | 5.868*** | 5.666*** | 5.993*** | 5.735*** | 6.098*** |
| 5 | 5.732*** | 5.777*** | 6.018*** | 5.599*** | 5.332** | 5.239** |

***f = 1***

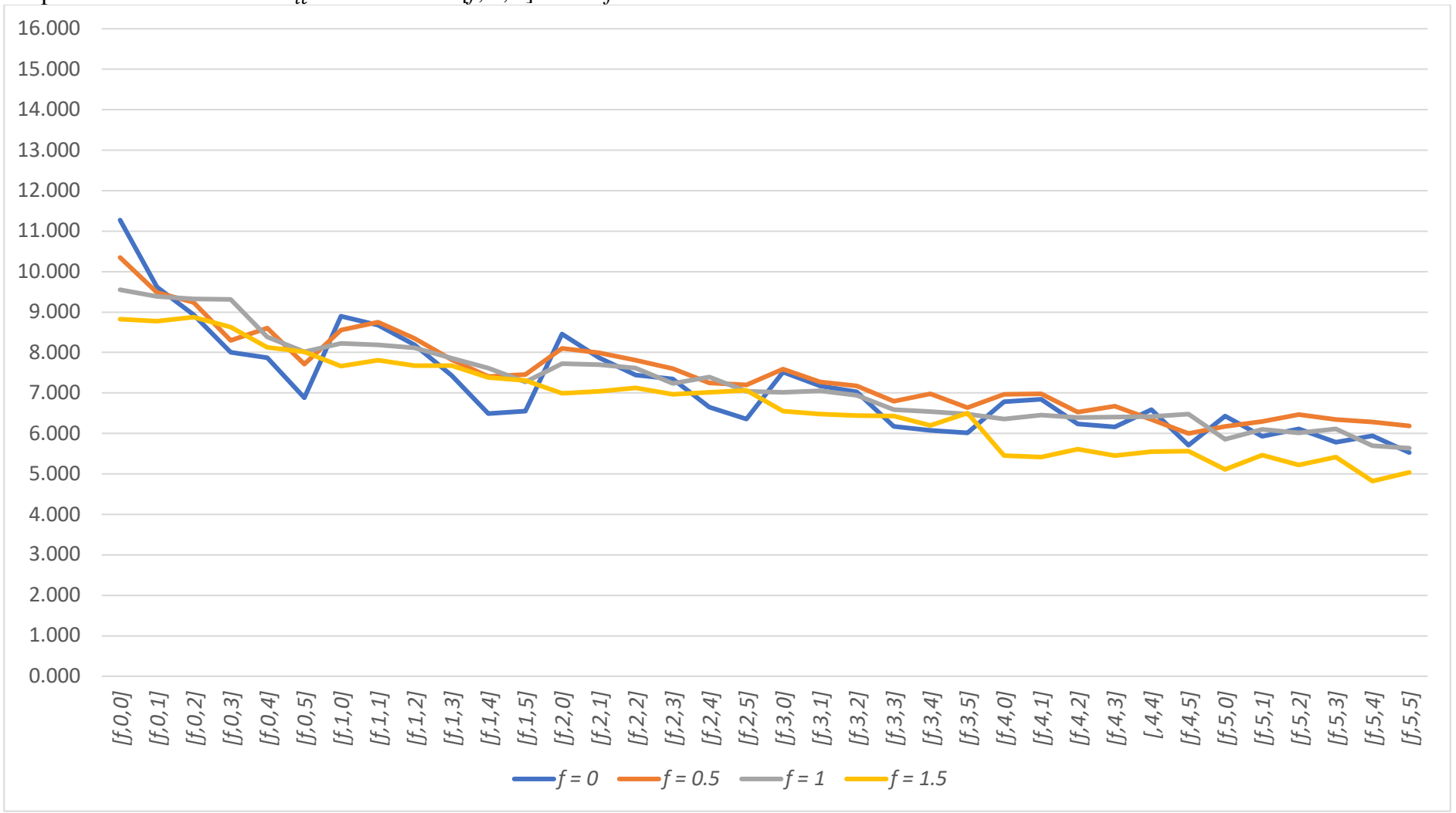
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.258*** | 7.690*** | 7.001*** | 6.692*** | 6.366*** | 5.451*** |
| 1 | 6.760*** | 6.774*** | 6.927*** | 6.501*** | 6.335*** | 6.399*** |
| 2 | 6.345*** | 6.178*** | 6.303*** | 6.341*** | 6.497*** | 5.734*** |
| 3 | 5.896*** | 6.108*** | 5.848*** | 6.050*** | 5.984*** | 5.875*** |
| 4 | 6.068*** | 5.983*** | 5.658*** | 5.869*** | 5.477*** | 5.895*** |
| 5 | 5.685*** | 5.380** | 5.446** | 5.613*** | 5.267** | 5.527** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.335*** | 7.189*** | 6.881*** | 6.917*** | 5.838*** | 6.191*** |
| 1 | 6.586*** | 6.554*** | 6.673*** | 6.069*** | 6.405*** | 6.170*** |
| 2 | 5.870*** | 5.789*** | 5.957*** | 6.088*** | 5.933*** | 5.749*** |
| 3 | 5.552*** | 5.468** | 5.321** | 5.904*** | 6.023*** | 5.830*** |
| 4 | 5.688*** | 5.467** | 5.368** | 5.471** | 5.322** | 5.120** |
| 5 | 5.338** | 5.191** | 5.226** | 5.075** | 5.032** | 4.846** |

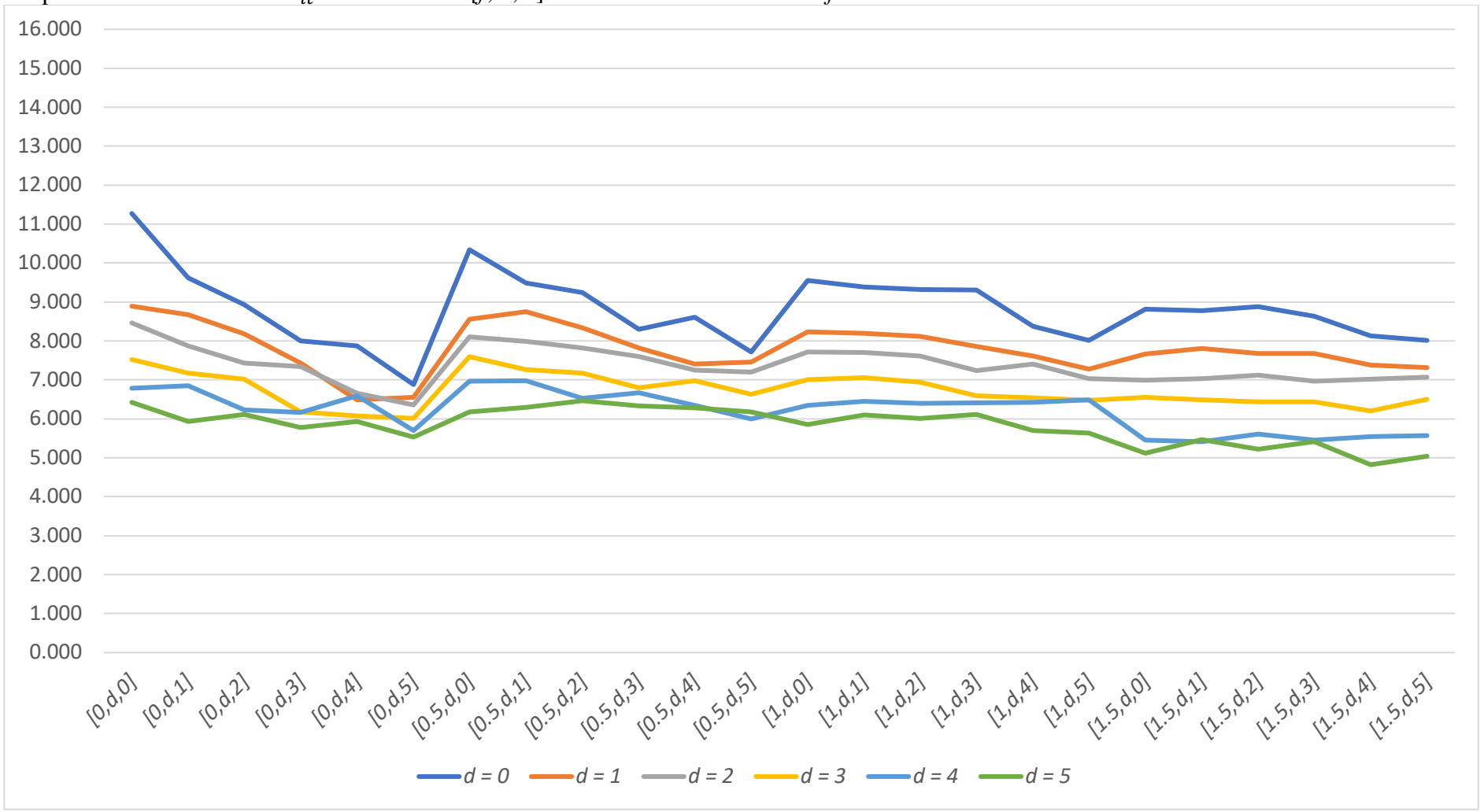
**Appendix 237: EW Health [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



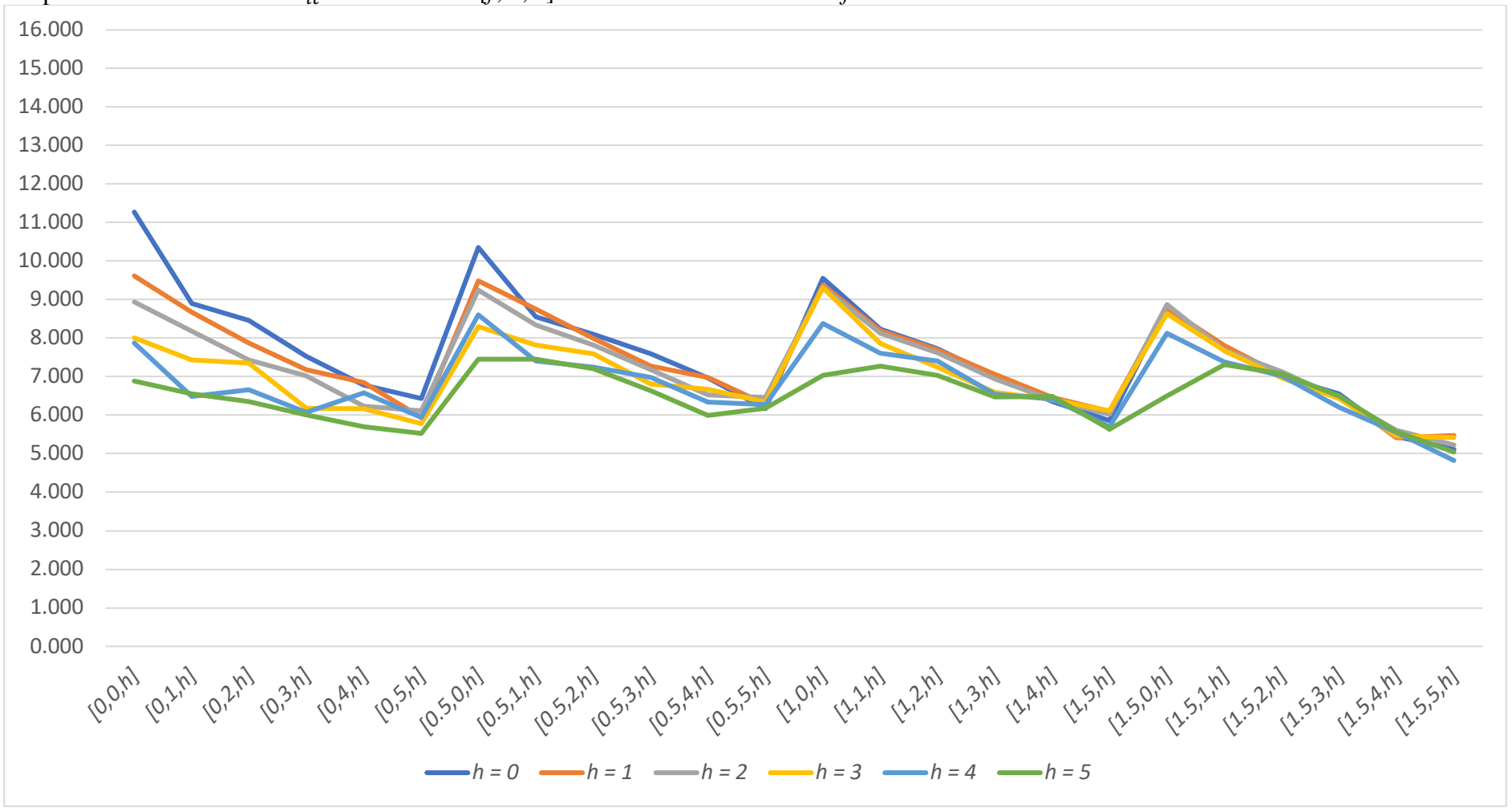
**Appendix 238: EW Health [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 239: EW Health [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 240: EW Health [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.273*** | 9.615*** | 8.939*** | 8.005*** | 7.870*** | 6.881*** |
| 1 | 8.893*** | 8.676*** | 8.186*** | 7.433*** | 6.488*** | 6.550*** |
| 2 | 8.463*** | 7.867*** | 7.439*** | 7.347*** | 6.654*** | 6.358*** |
| 3 | 7.523*** | 7.175*** | 7.024*** | 6.178*** | 6.079*** | 6.013*** |
| 4 | 6.781*** | 6.849*** | 6.233*** | 6.167*** | 6.586*** | 5.705*** |
| 5 | 6.430*** | 5.935*** | 6.115*** | 5.780*** | 5.938*** | 5.528*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.348*** | 9.486*** | 9.243*** | 8.294*** | 8.605*** | 7.711*** |
| 1 | 8.558*** | 8.753*** | 8.344*** | 7.818*** | 7.404*** | 7.453*** |
| 2 | 8.103*** | 7.993*** | 7.816*** | 7.598*** | 7.249*** | 7.204*** |
| 3 | 7.596*** | 7.270*** | 7.178*** | 6.802*** | 6.984*** | 6.634*** |
| 4 | 6.962*** | 6.979*** | 6.524*** | 6.669*** | 6.343*** | 5.999*** |
| 5 | 6.173*** | 6.291*** | 6.465*** | 6.340*** | 6.278*** | 6.184*** |

***f = 1***

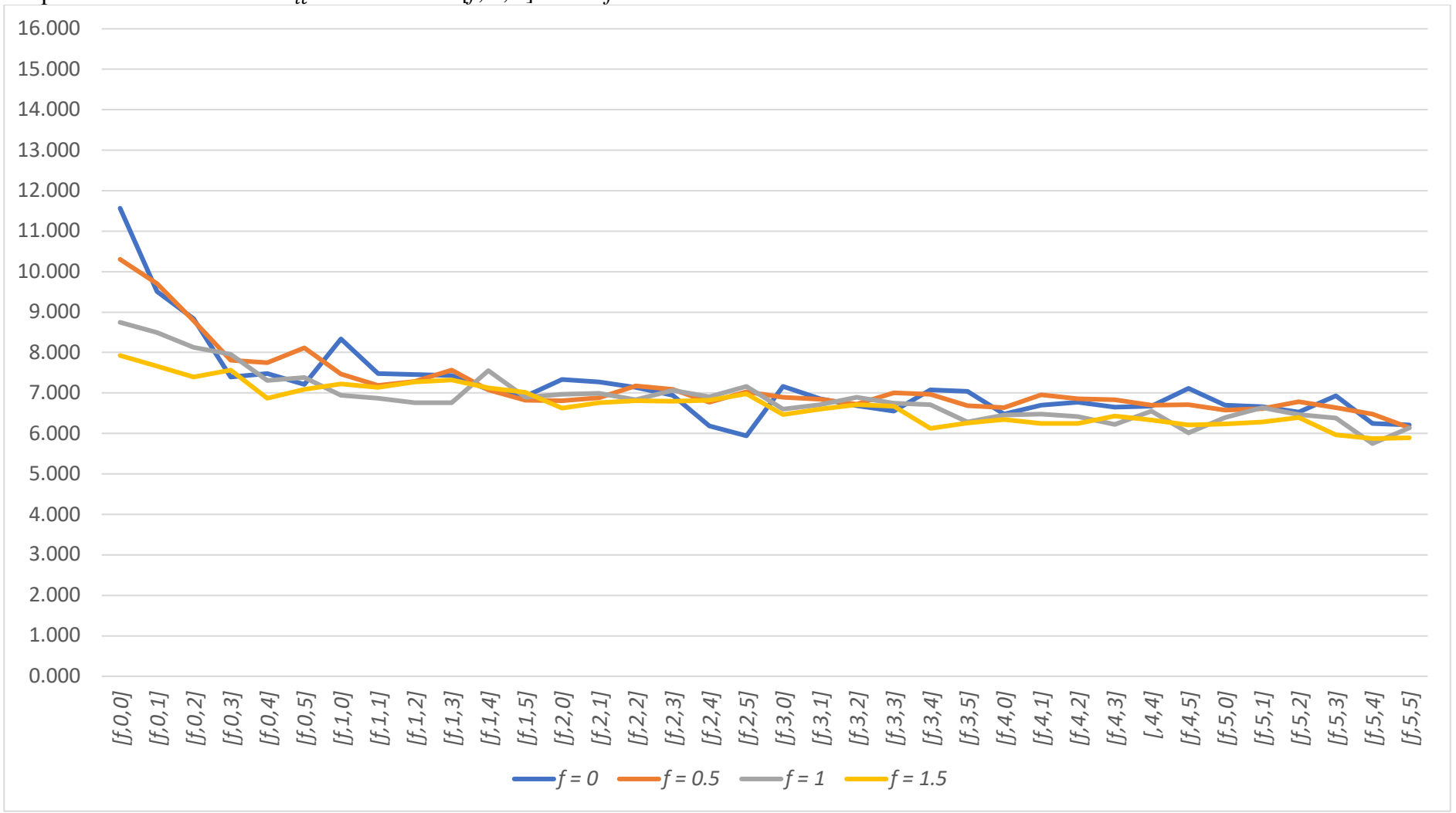
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.551*** | 8.893*** | 8.676*** | 8.186*** | 7.433*** | 6.488*** |
| 1 | 8.229*** | 8.193*** | 8.121*** | 7.864*** | 7.609*** | 7.272*** |
| 2 | 7.720*** | 7.704*** | 7.616*** | 7.242*** | 7.401*** | 7.037*** |
| 3 | 7.011*** | 7.057*** | 6.944*** | 6.594*** | 6.536*** | 6.479*** |
| 4 | 6.351*** | 6.455*** | 6.395*** | 6.410*** | 6.423*** | 6.484*** |
| 5 | 5.856*** | 6.098*** | 6.016*** | 6.108*** | 5.694*** | 5.636*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.821*** | 8.558*** | 8.753*** | 8.344*** | 7.818*** | 7.404*** |
| 1 | 7.669*** | 7.811*** | 7.681*** | 7.674*** | 7.378*** | 7.313*** |
| 2 | 6.997*** | 7.036*** | 7.124*** | 6.973*** | 7.017*** | 7.071*** |
| 3 | 6.550*** | 6.484*** | 6.442*** | 6.434*** | 6.200*** | 6.504*** |
| 4 | 5.451*** | 5.413*** | 5.607*** | 5.454*** | 5.548*** | 5.569*** |
| 5 | 5.114*** | 5.467*** | 5.227*** | 5.418*** | 4.823*** | 5.043*** |

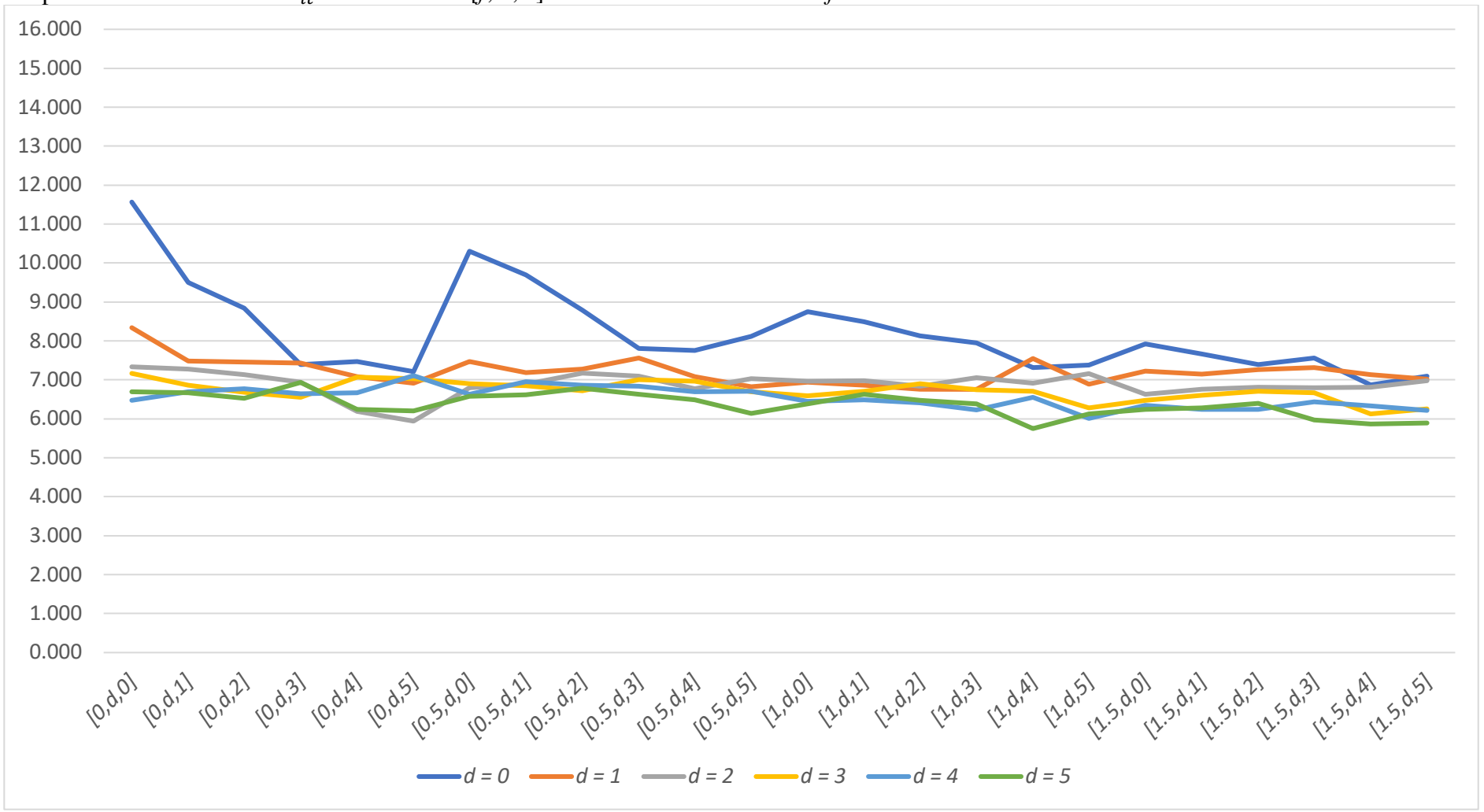
**Appendix 241: VW Textiles [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



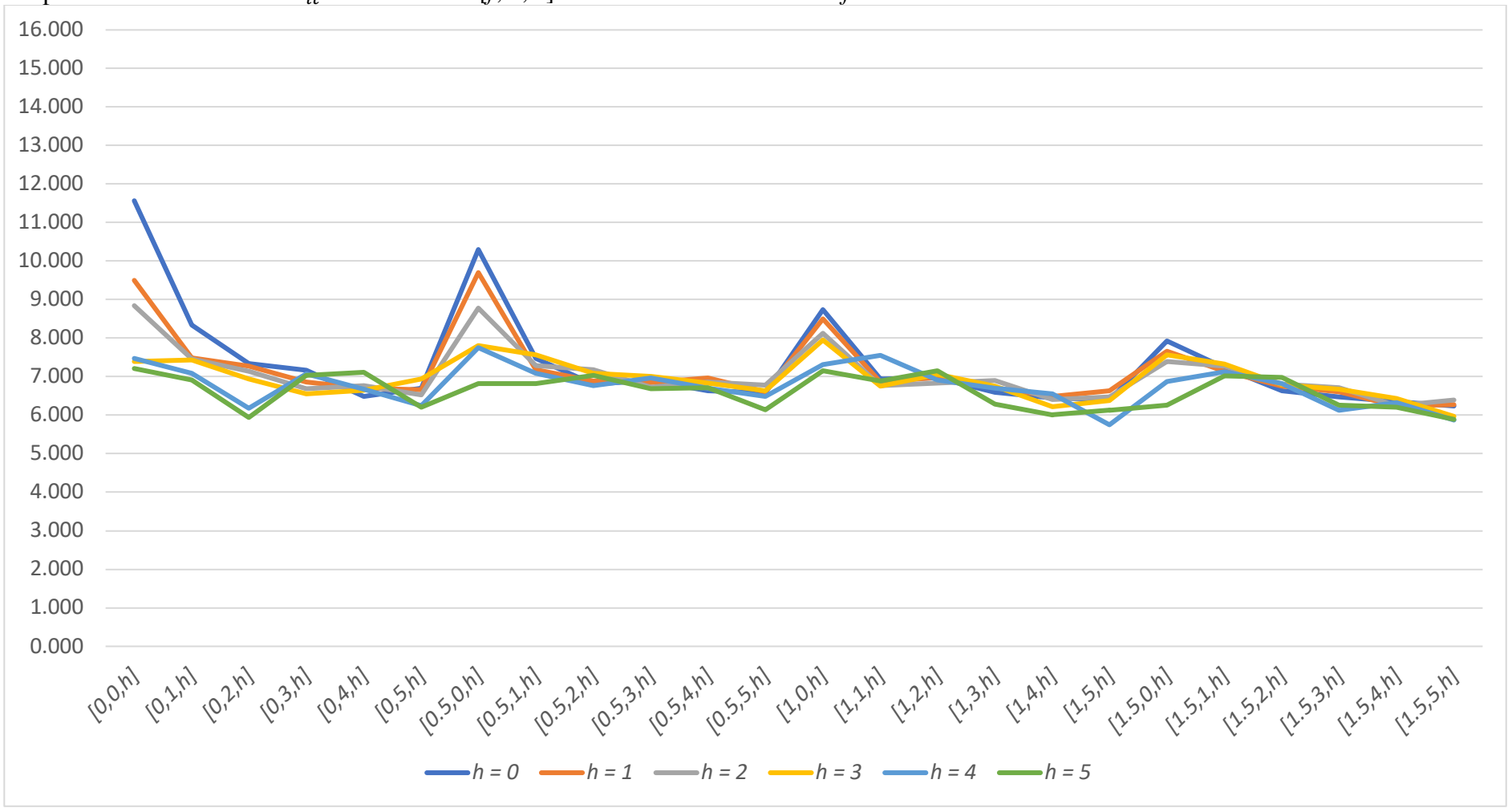
**Appendix 242: VW Textiles [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 243: VW Textiles [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 244: VW Textiles [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.566*** | 9.502*** | 8.842*** | 7.395*** | 7.477*** | 7.211*** |
| 1 | 8.341*** | 7.481*** | 7.454*** | 7.430*** | 7.088*** | 6.913*** |
| 2 | 7.336*** | 7.277*** | 7.139*** | 6.946*** | 6.185*** | 5.942*** |
| 3 | 7.167*** | 6.863*** | 6.689*** | 6.554*** | 7.073*** | 7.037*** |
| 4 | 6.481*** | 6.702*** | 6.767*** | 6.650*** | 6.670*** | 7.110*** |
| 5 | 6.695*** | 6.664*** | 6.524*** | 6.935*** | 6.245*** | 6.208*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.303*** | 9.701*** | 8.785*** | 7.810*** | 7.753*** | 8.116*** |
| 1 | 7.473*** | 7.185*** | 7.283*** | 7.567*** | 7.081*** | 6.821*** |
| 2 | 6.804*** | 6.887*** | 7.177*** | 7.090*** | 6.771*** | 7.027*** |
| 3 | 6.899*** | 6.849*** | 6.721*** | 7.005*** | 6.973*** | 6.692*** |
| 4 | 6.634*** | 6.960*** | 6.858*** | 6.833*** | 6.700*** | 6.714*** |
| 5 | 6.580*** | 6.612*** | 6.784*** | 6.637*** | 6.483*** | 6.143*** |

***f = 1***

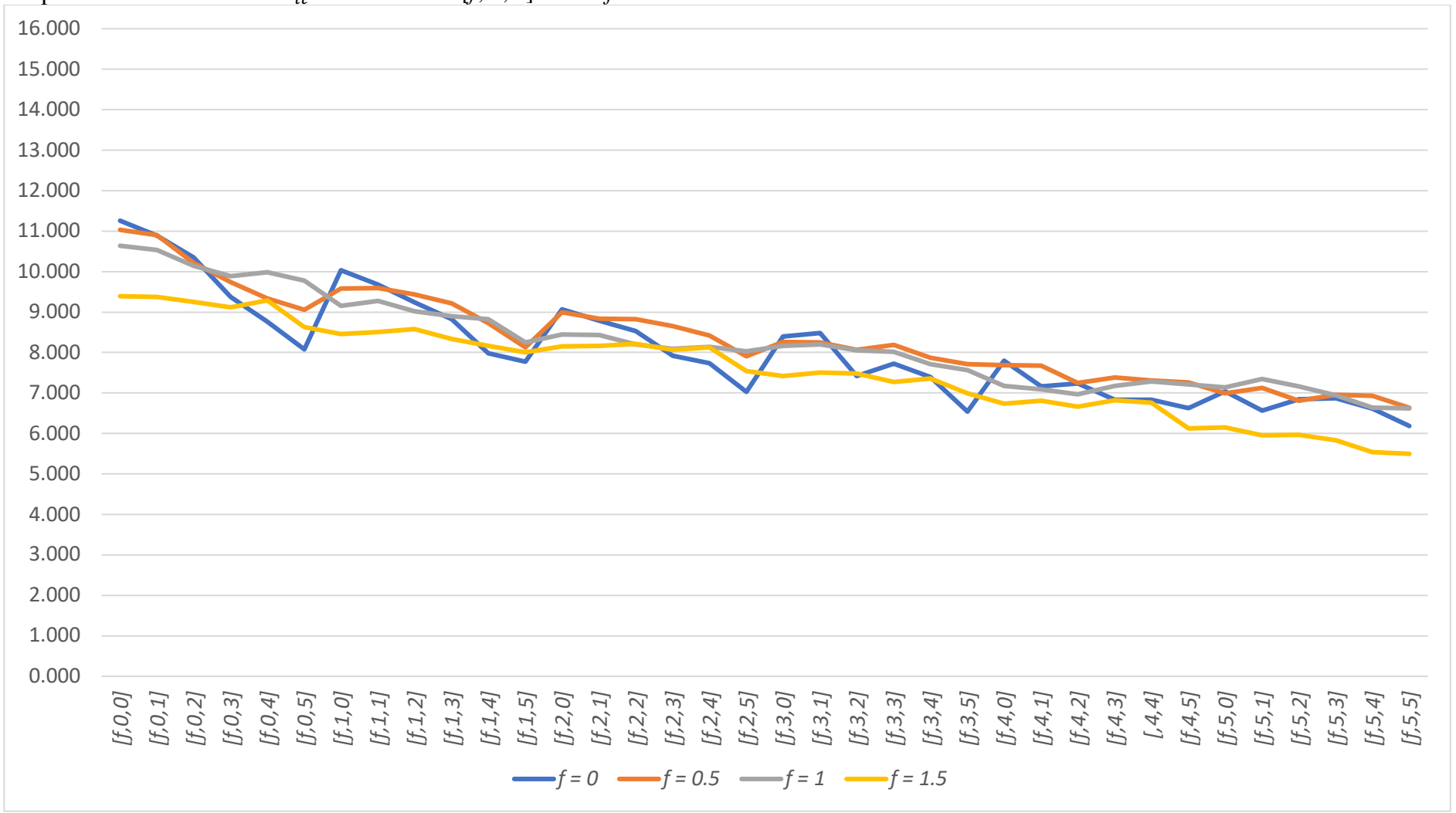
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 8.746*** | 8.341*** | 7.481*** | 7.454*** | 7.430*** | 7.088*** |
| 1 | 6.941*** | 6.864*** | 6.763*** | 6.757*** | 7.551*** | 6.889*** |
| 2 | 6.969*** | 6.986*** | 6.834*** | 7.060*** | 6.909*** | 7.157*** |
| 3 | 6.596*** | 6.708*** | 6.900*** | 6.749*** | 6.706*** | 6.280*** |
| 4 | 6.452*** | 6.485*** | 6.413*** | 6.226*** | 6.556*** | 6.011*** |
| 5 | 6.391*** | 6.636*** | 6.470*** | 6.380*** | 5.750*** | 6.132*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 7.927*** | 7.473*** | 7.185*** | 7.283*** | 7.567*** | 7.081*** |
| 1 | 7.227*** | 7.144*** | 7.270*** | 7.320*** | 7.129*** | 7.016*** |
| 2 | 6.629*** | 6.755*** | 6.811*** | 6.797*** | 6.815*** | 6.985*** |
| 3 | 6.471*** | 6.601*** | 6.712*** | 6.675*** | 6.127*** | 6.260*** |
| 4 | 6.350*** | 6.241*** | 6.248*** | 6.434*** | 6.329*** | 6.213*** |
| 5 | 6.238*** | 6.279*** | 6.397*** | 5.969*** | 5.874*** | 5.891*** |

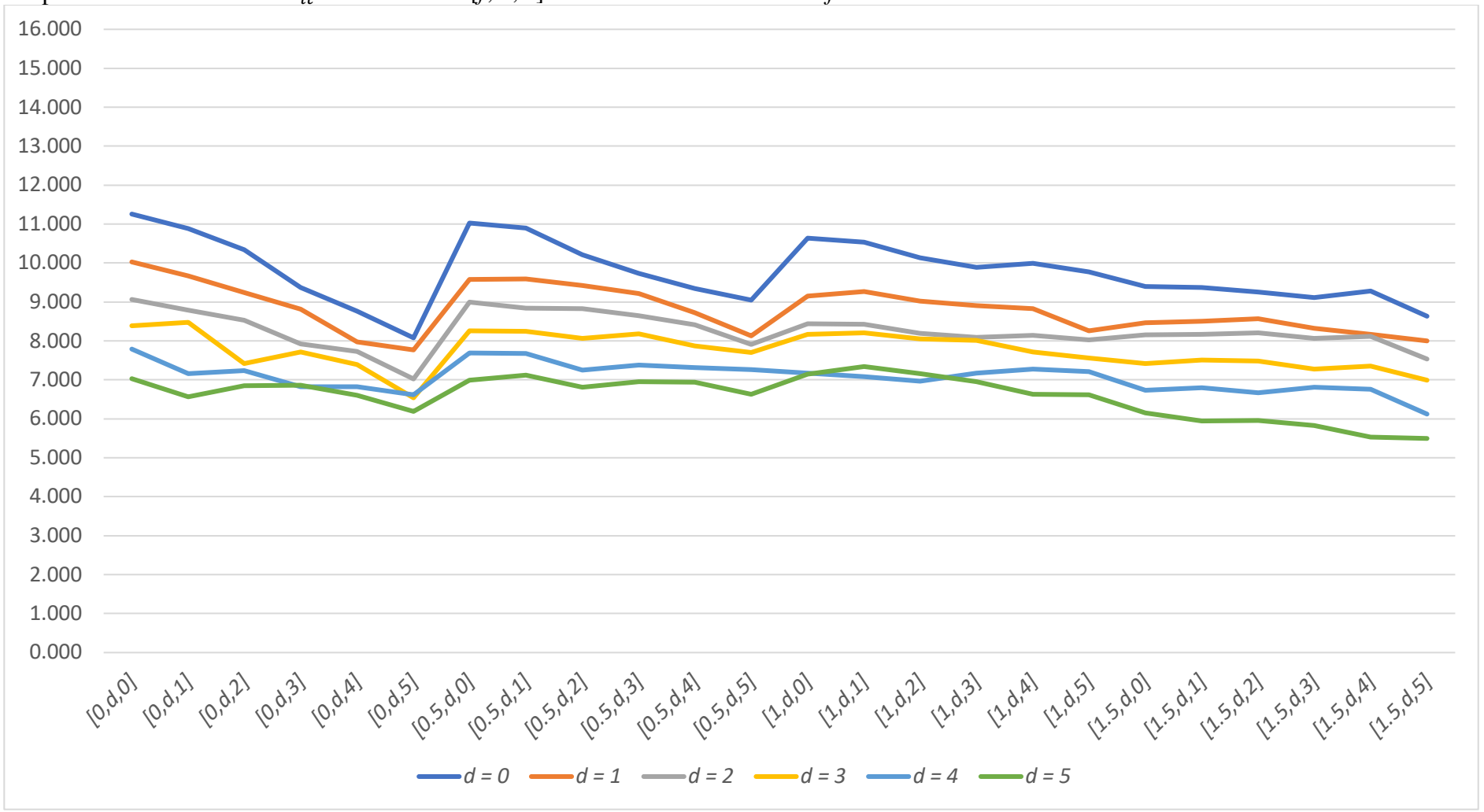
**Appendix 245: EW Textiles [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



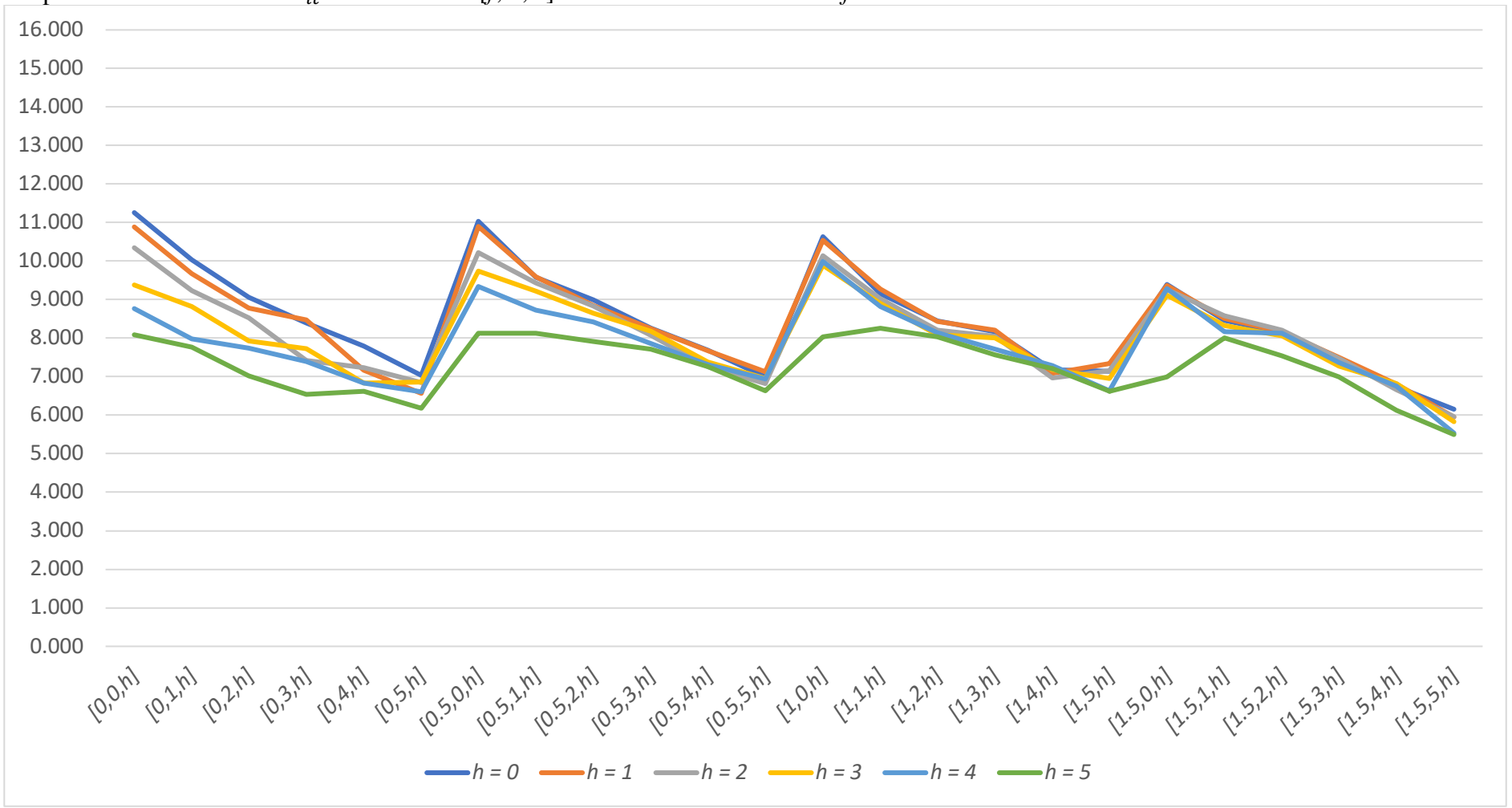
**Appendix 246: EW Textiles [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 247: EW Textiles [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 248: EW Textiles [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.258*** | 10.886*** | 10.346*** | 9.373*** | 8.765*** | 8.080*** |
| 1 | 10.029*** | 9.674*** | 9.237*** | 8.820*** | 7.976*** | 7.770*** |
| 2 | 9.065*** | 8.785*** | 8.531*** | 7.926*** | 7.734*** | 7.025*** |
| 3 | 8.394*** | 8.478*** | 7.419*** | 7.722*** | 7.399*** | 6.540*** |
| 4 | 7.792*** | 7.162*** | 7.237*** | 6.828*** | 6.831*** | 6.623*** |
| 5 | 7.038*** | 6.560*** | 6.851*** | 6.866*** | 6.608*** | 6.185*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.032*** | 10.899*** | 10.213*** | 9.737*** | 9.341*** | 9.052*** |
| 1 | 9.579*** | 9.593*** | 9.430*** | 9.216*** | 8.723*** | 8.131*** |
| 2 | 8.997*** | 8.840*** | 8.827*** | 8.647*** | 8.415*** | 7.913*** |
| 3 | 8.262*** | 8.244*** | 8.068*** | 8.183*** | 7.866*** | 7.707*** |
| 4 | 7.686*** | 7.673*** | 7.254*** | 7.384*** | 7.313*** | 7.264*** |
| 5 | 6.990*** | 7.124*** | 6.814*** | 6.954*** | 6.937*** | 6.635*** |

***f = 1***

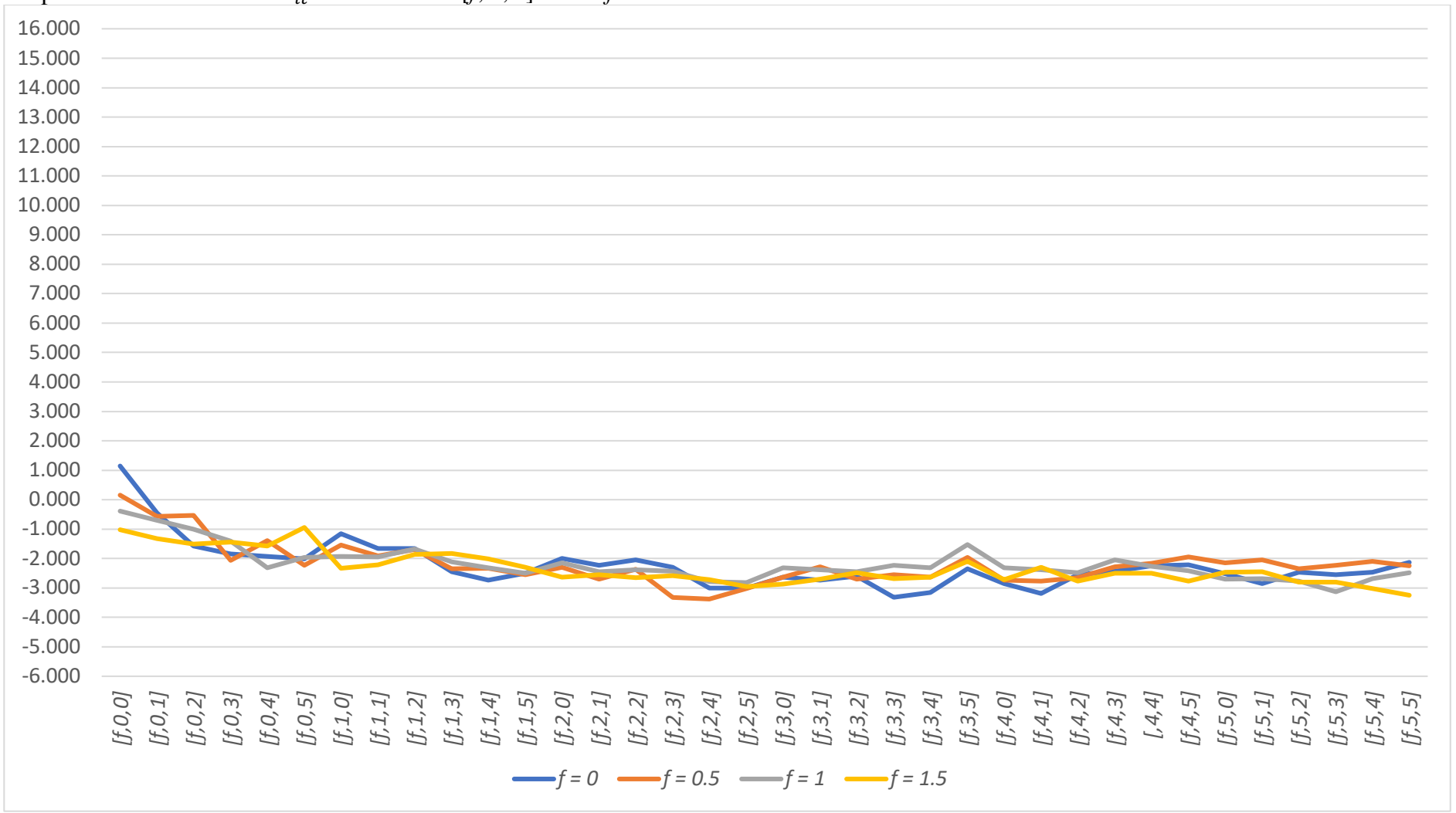
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.638*** | 10.029*** | 9.674*** | 9.237*** | 8.820*** | 7.976*** |
| 1 | 9.157*** | 9.273*** | 9.025*** | 8.902*** | 8.823*** | 8.256*** |
| 2 | 8.445*** | 8.429*** | 8.202*** | 8.092*** | 8.139*** | 8.030*** |
| 3 | 8.169*** | 8.204*** | 8.050*** | 8.012*** | 7.715*** | 7.562*** |
| 4 | 7.178*** | 7.086*** | 6.968*** | 7.174*** | 7.280*** | 7.210*** |
| 5 | 7.142*** | 7.343*** | 7.158*** | 6.948*** | 6.634*** | 6.620*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.392*** | 9.579*** | 9.593*** | 9.430*** | 9.216*** | 8.723*** |
| 1 | 8.461*** | 8.511*** | 8.575*** | 8.330*** | 8.167*** | 8.003*** |
| 2 | 8.153*** | 8.169*** | 8.211*** | 8.061*** | 8.122*** | 7.540*** |
| 3 | 7.425*** | 7.505*** | 7.478*** | 7.278*** | 7.360*** | 6.991*** |
| 4 | 6.737*** | 6.803*** | 6.664*** | 6.816*** | 6.755*** | 6.123*** |
| 5 | 6.154*** | 5.950*** | 5.961*** | 5.831*** | 5.536*** | 5.497*** |

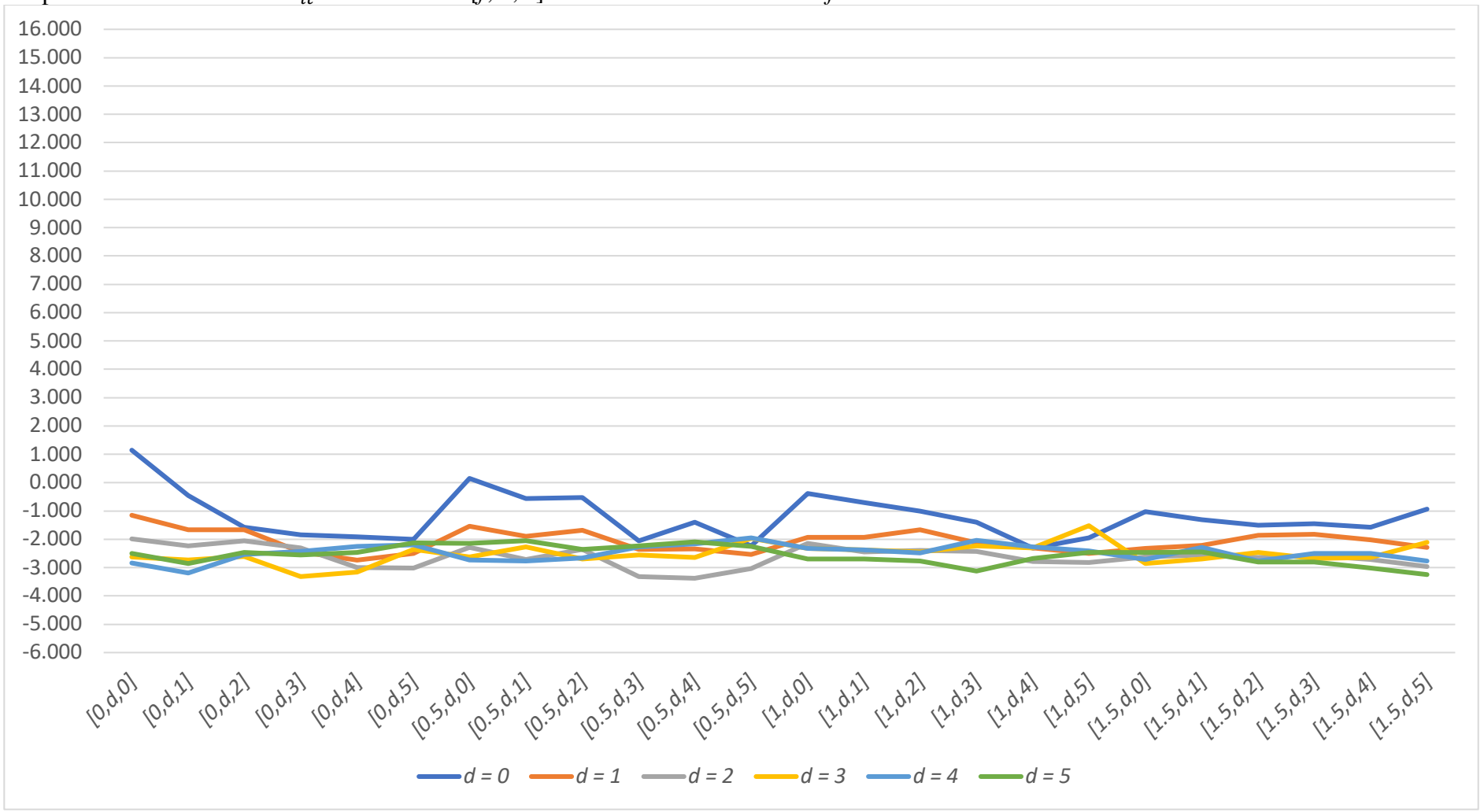
**Appendix 249: VW Hardware [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



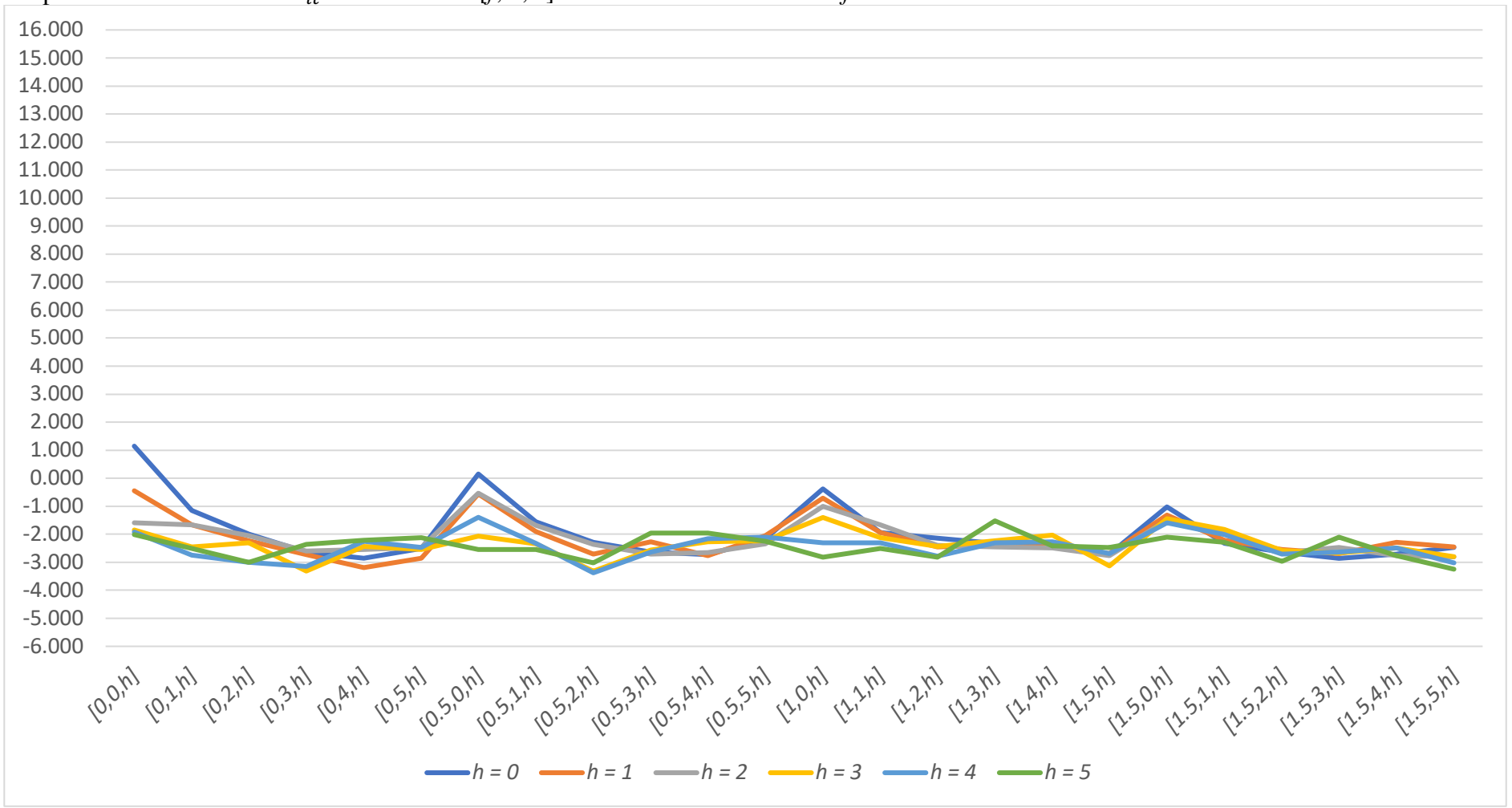
**Appendix 250: VW Hardware [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 251: VW Hardware [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 252: VW Hardware [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 1.145 | -0.448 | -1.583 | -1.840 | -1.921 | -2.011 |
| 1 | -1.153 | -1.666 | -1.658 | -2.456 | -2.737 | -2.505 |
| 2 | -1.987 | -2.237 | -2.049 | -2.301 | -3.004* | -3.009* |
| 3 | -2.628 | -2.730 | -2.603 | -3.317* | -3.157* | -2.353 |
| 4 | -2.847 | -3.191* | -2.544 | -2.433 | -2.253 | -2.207 |
| 5 | -2.509 | -2.849* | -2.470 | -2.551 | -2.473 | -2.124 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0.154 | -0.570 | -0.535 | -2.061 | -1.395 | -2.231 |
| 1 | -1.549 | -1.905 | -1.690 | -2.350 | -2.333 | -2.542 |
| 2 | -2.294 | -2.706 | -2.362 | -3.318* | -3.377** | -3.027* |
| 3 | -2.627 | -2.277 | -2.704 | -2.556 | -2.635 | -1.963 |
| 4 | -2.733 | -2.773 | -2.654 | -2.275 | -2.165 | -1.951 |
| 5 | -2.153 | -2.051 | -2.351 | -2.226 | -2.095 | -2.254 |

***f = 1***

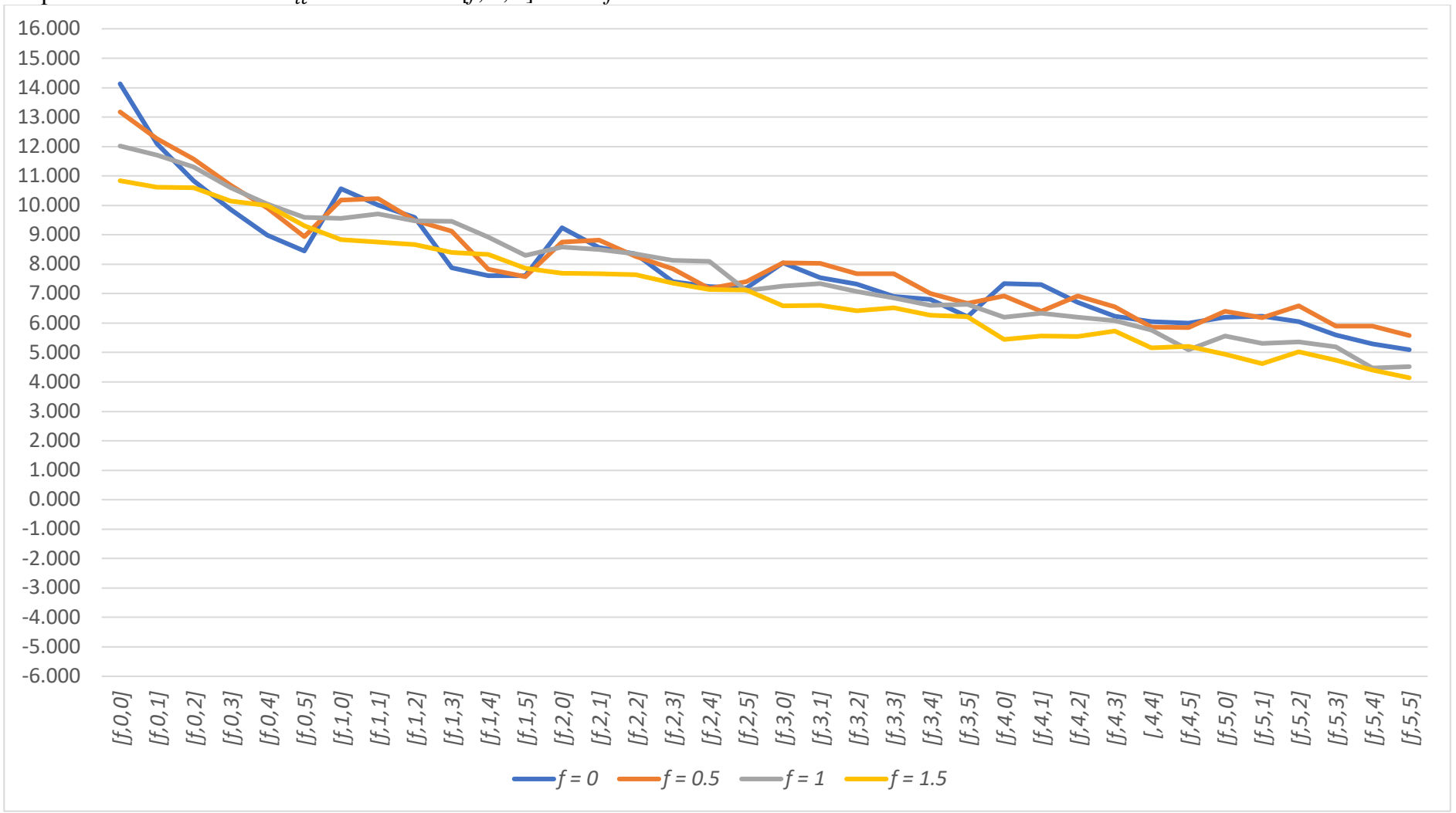
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | -0.388 | -1.153 | -1.666 | -1.658 | -2.456 | -2.737 |
| 1 | -1.931 | -1.939 | -1.672 | -2.119 | -2.314 | -2.503 |
| 2 | -2.140 | -2.444 | -2.389 | -2.436 | -2.786 | -2.818 |
| 3 | -2.322 | -2.378 | -2.452 | -2.230 | -2.311 | -1.521 |
| 4 | -2.321 | -2.384 | -2.488 | -2.037 | -2.268 | -2.413 |
| 5 | -2.705 | -2.688 | -2.769 | -3.130* | -2.687 | -2.474 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | -1.019 | -1.549 | -1.905 | -1.690 | -2.350 | -2.333 |
| 1 | -2.323 | -2.208 | -1.864 | -1.833 | -2.015 | -2.291 |
| 2 | -2.628 | -2.551 | -2.646 | -2.576 | -2.718 | -2.960* |
| 3 | -2.861 | -2.697 | -2.474 | -2.677 | -2.638 | -2.103 |
| 4 | -2.717 | -2.296 | -2.767 | -2.493 | -2.496 | -2.763 |
| 5 | -2.469 | -2.449 | -2.807 | -2.795 | -3.018* | -3.247* |

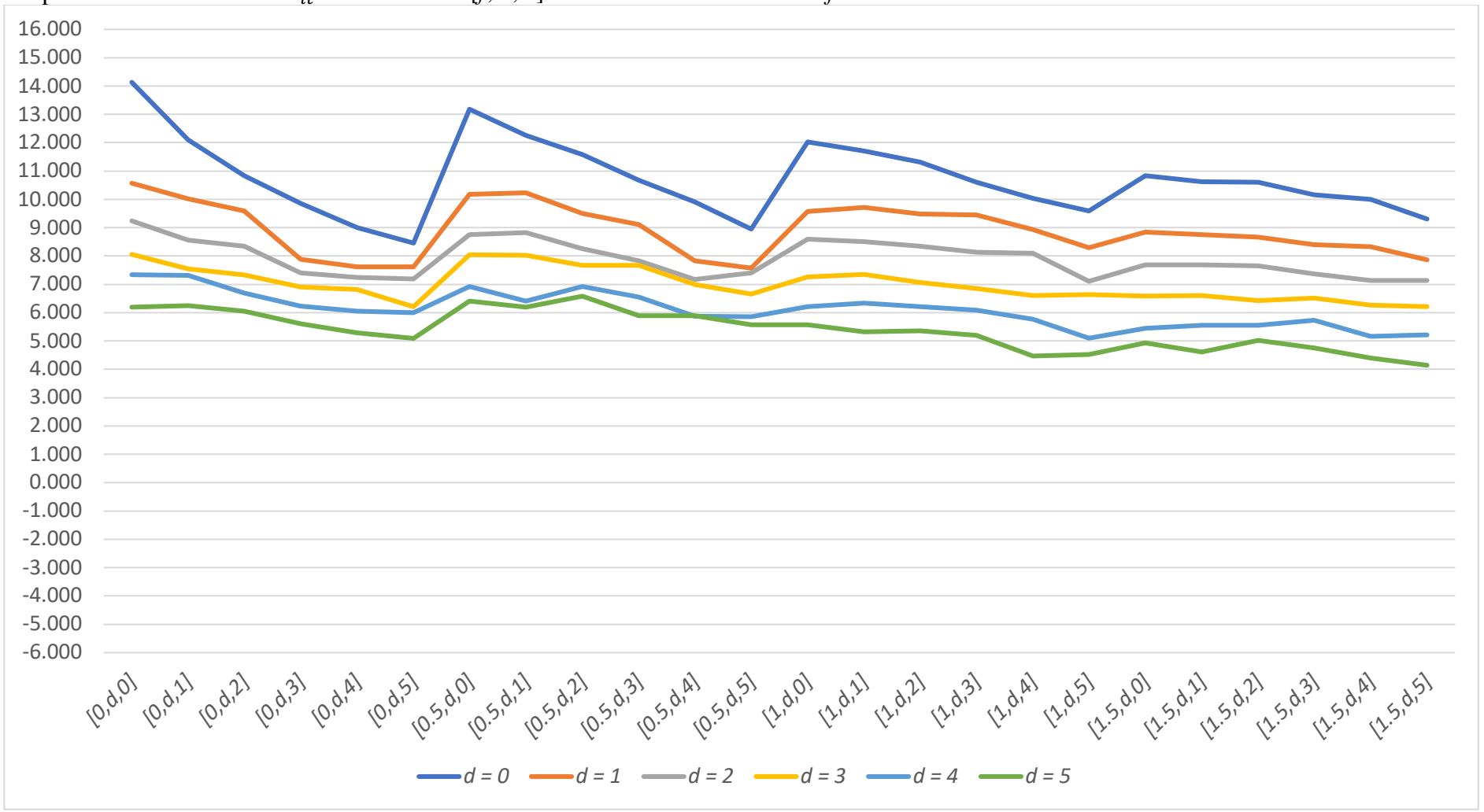
**Appendix 253: EW Hardware [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



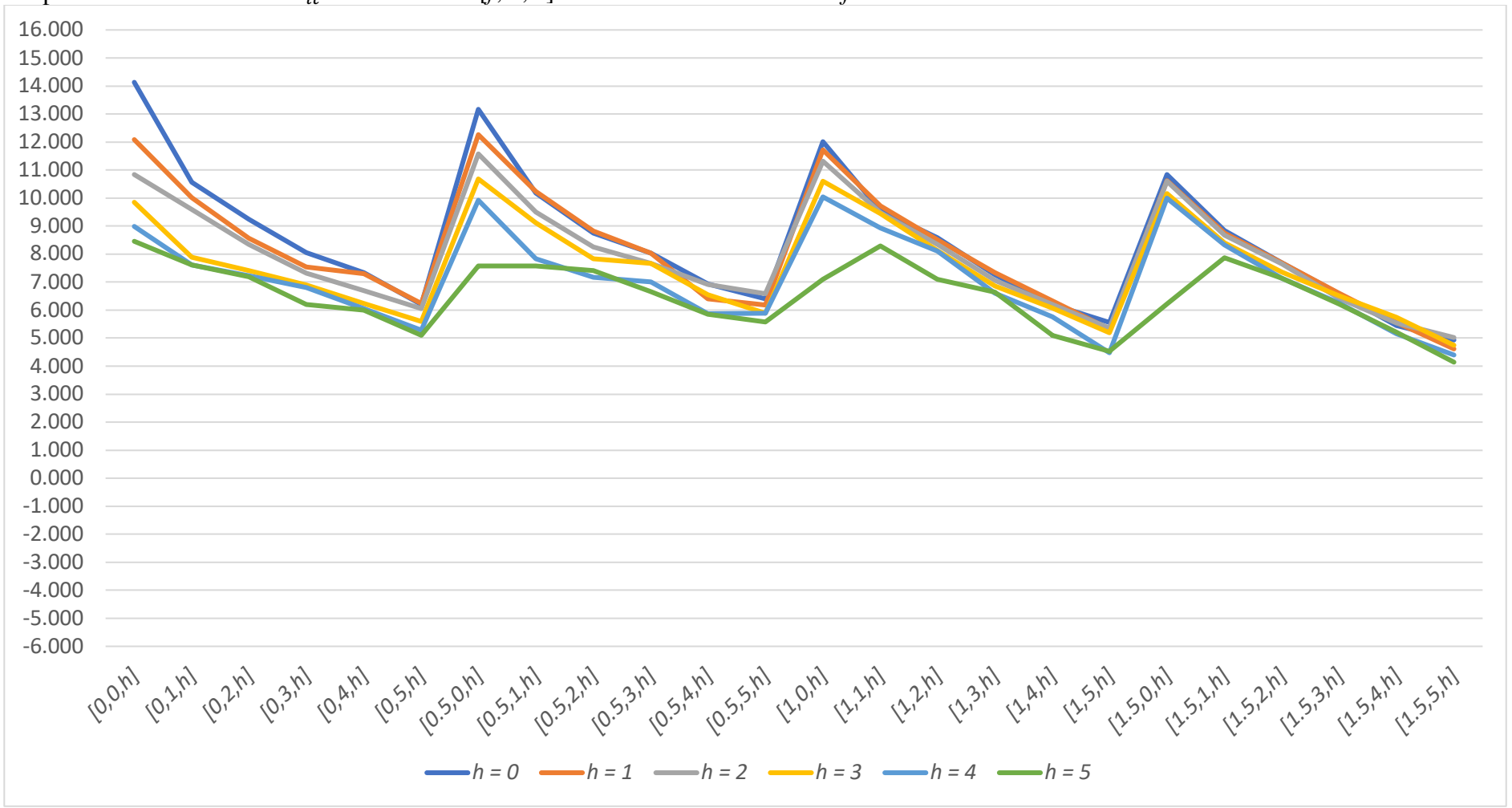
**Appendix 254: EW Hardware [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 255: EW Hardware [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 256: EW Hardware [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 14.131*** | 12.094*** | 10.842*** | 9.856*** | 8.994*** | 8.456*** |
| 1 | 10.569*** | 10.008*** | 9.587*** | 7.881*** | 7.617*** | 7.607*** |
| 2 | 9.238*** | 8.564*** | 8.351*** | 7.408*** | 7.236*** | 7.189*** |
| 3 | 8.055*** | 7.544*** | 7.326*** | 6.905*** | 6.807*** | 6.209*** |
| 4 | 7.339*** | 7.306*** | 6.696*** | 6.232*** | 6.054*** | 5.992*** |
| 5 | 6.202*** | 6.241*** | 6.052*** | 5.599*** | 5.290*** | 5.095*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.175*** | 12.262*** | 11.575*** | 10.682*** | 9.918*** | 8.945*** |
| 1 | 10.173*** | 10.225*** | 9.500*** | 9.118*** | 7.827*** | 7.573*** |
| 2 | 8.746*** | 8.823*** | 8.260*** | 7.838*** | 7.177*** | 7.407*** |
| 3 | 8.041*** | 8.032*** | 7.672*** | 7.672*** | 6.998*** | 6.662*** |
| 4 | 6.928*** | 6.407*** | 6.922*** | 6.550*** | 5.868*** | 5.853*** |
| 5 | 6.398*** | 6.188*** | 6.581*** | 5.895*** | 5.894*** | 5.578*** |

***f = 1***

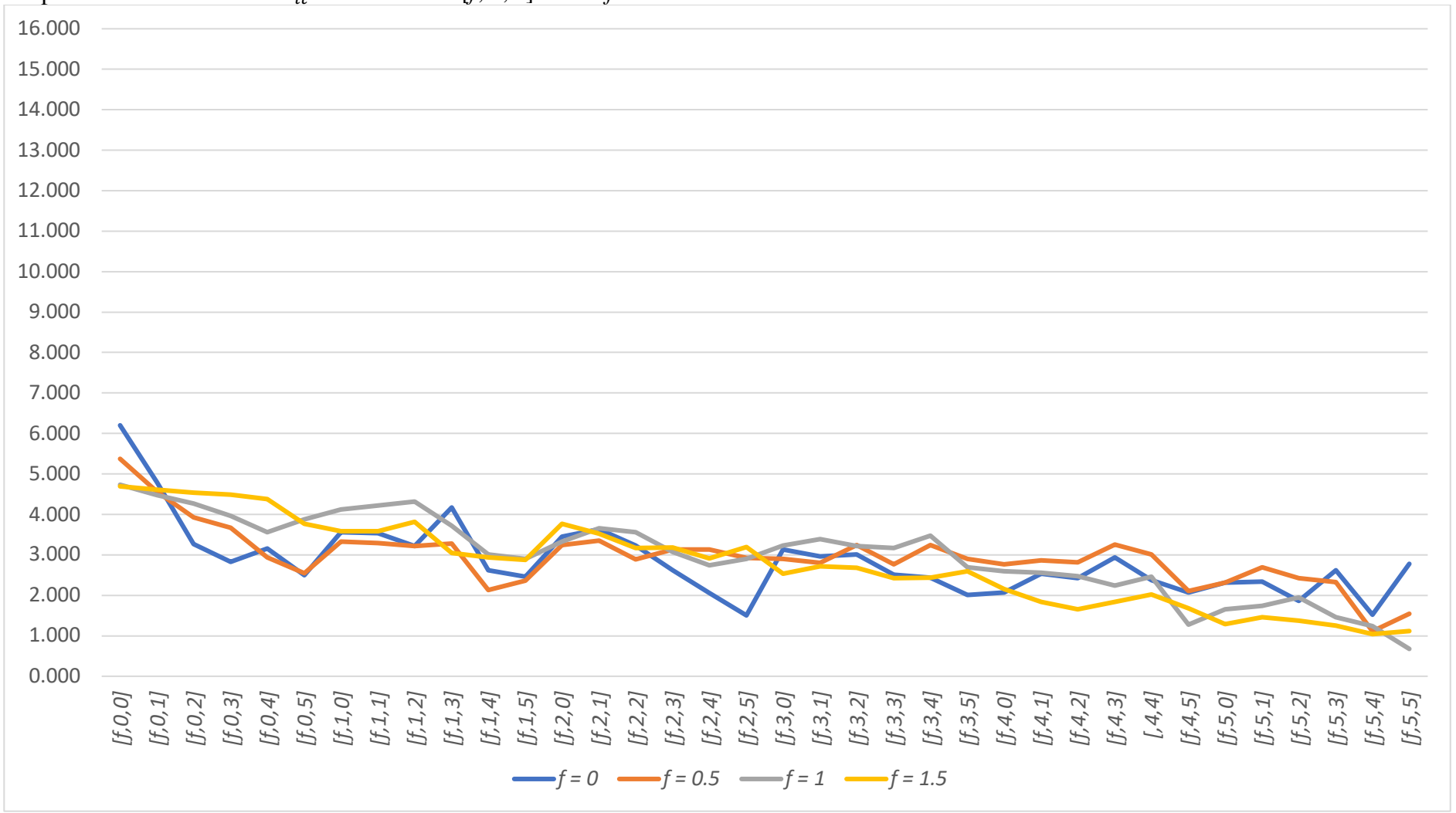
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.017*** | 10.569*** | 10.008*** | 9.587*** | 7.881*** | 7.617*** |
| 1 | 9.564*** | 9.716*** | 9.480*** | 9.451*** | 8.926*** | 8.298*** |
| 2 | 8.590*** | 8.509*** | 8.342*** | 8.126*** | 8.099*** | 7.106*** |
| 3 | 7.259*** | 7.346*** | 7.070*** | 6.855*** | 6.604*** | 6.635*** |
| 4 | 6.204*** | 6.330*** | 6.205*** | 6.080*** | 5.764*** | 5.098*** |
| 5 | 5.565*** | 5.318*** | 5.356*** | 5.196*** | 4.474*** | 4.525*** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.838*** | 10.173*** | 10.225*** | 9.500*** | 9.118*** | 7.827*** |
| 1 | 8.841*** | 8.750*** | 8.673*** | 8.396*** | 8.334*** | 7.862*** |
| 2 | 7.691*** | 7.680*** | 7.643*** | 7.361*** | 7.143*** | 7.129*** |
| 3 | 6.580*** | 6.599*** | 6.425*** | 6.517*** | 6.259*** | 6.211*** |
| 4 | 5.443*** | 5.554*** | 5.548*** | 5.733*** | 5.160*** | 5.211*** |
| 5 | 4.934*** | 4.615*** | 5.021*** | 4.746*** | 4.398*** | 4.142*** |

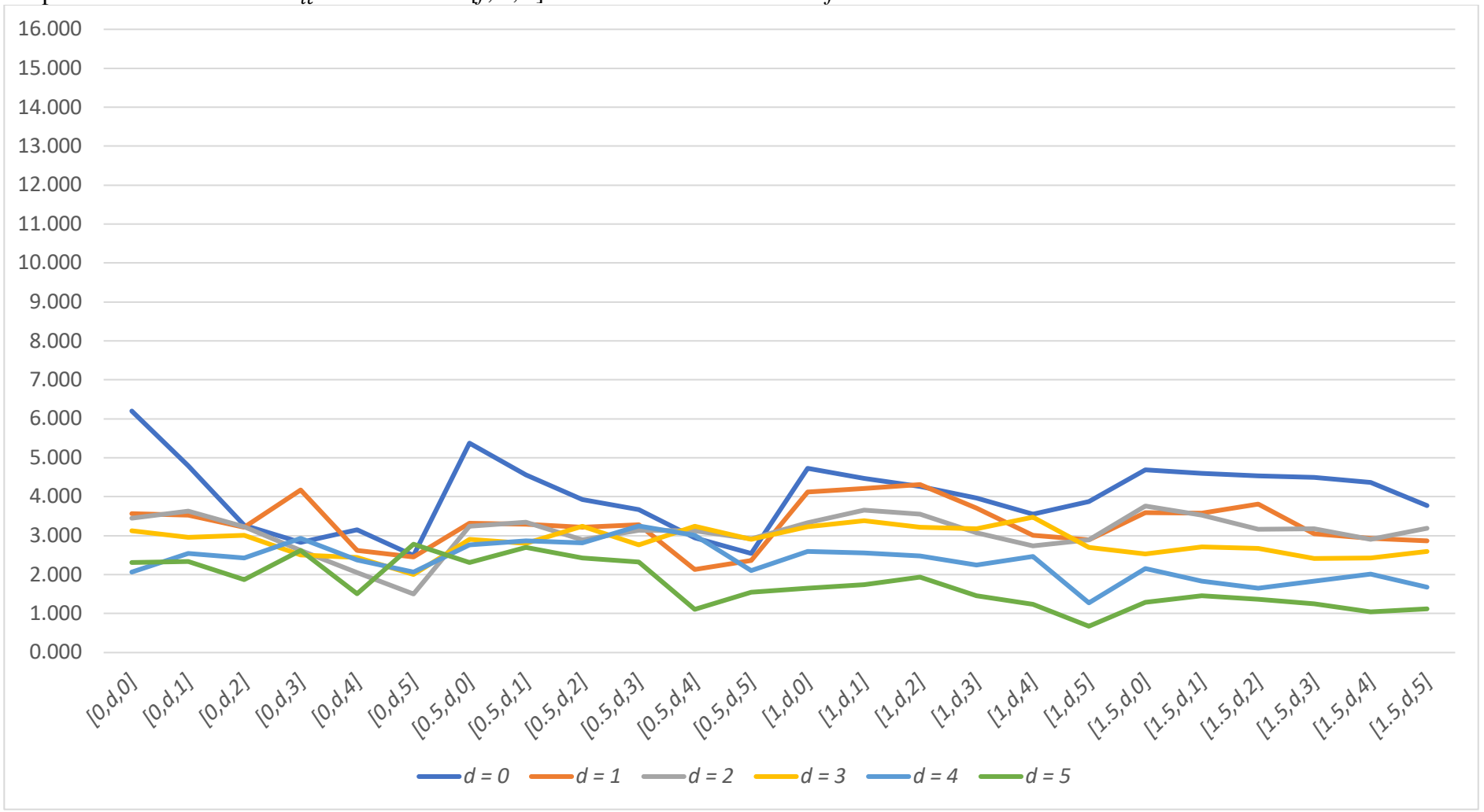
**Appendix 257: VW Software [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



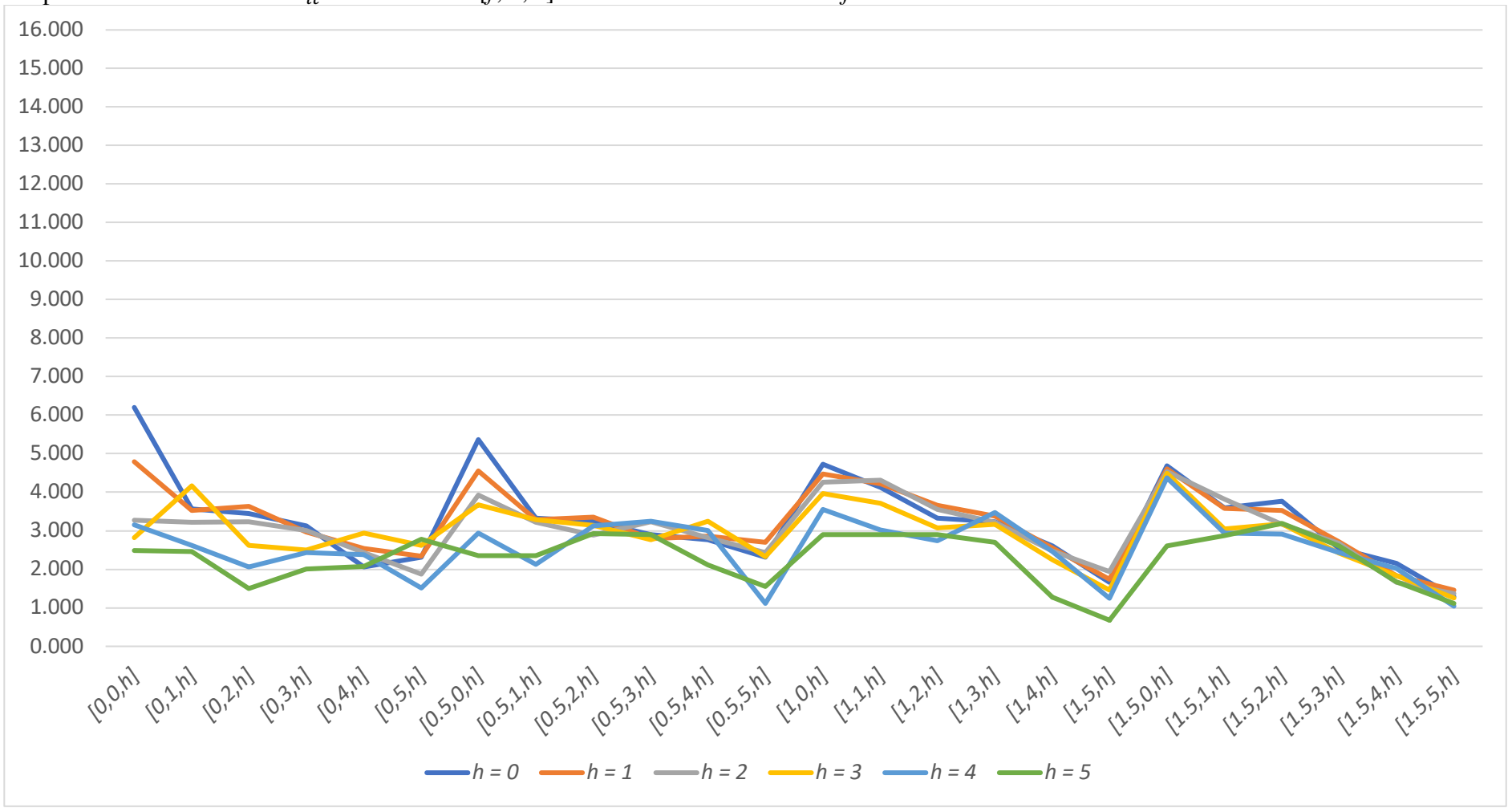
**Appendix 258: VW Software [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 259: VW Software [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 260: VW Software [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 6.201** | 4.792* | 3.272 | 2.823 | 3.154 | 2.493 |
| 1 | 3.566 | 3.532 | 3.217 | 4.170 | 2.625 | 2.458 |
| 2 | 3.451 | 3.633 | 3.227 | 2.616 | 2.058 | 1.504 |
| 3 | 3.130 | 2.965 | 3.011 | 2.505 | 2.438 | 2.005 |
| 4 | 2.065 | 2.540 | 2.429 | 2.938 | 2.374 | 2.072 |
| 5 | 2.311 | 2.344 | 1.867 | 2.618 | 1.515 | 2.782 |

***f = 0.5***

| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 5.373* | 4.556 | 3.930 | 3.669 | 2.940 | 2.548 |
| 1 | 3.325 | 3.293 | 3.222 | 3.283 | 2.133 | 2.359 |
| 2 | 3.243 | 3.350 | 2.892 | 3.135 | 3.132 | 2.923 |
| 3 | 2.906 | 2.797 | 3.237 | 2.762 | 3.241 | 2.901 |
| 4 | 2.771 | 2.863 | 2.815 | 3.250 | 3.008 | 2.109 |
| 5 | 2.313 | 2.697 | 2.428 | 2.325 | 1.112 | 1.547 |

***f = 1***

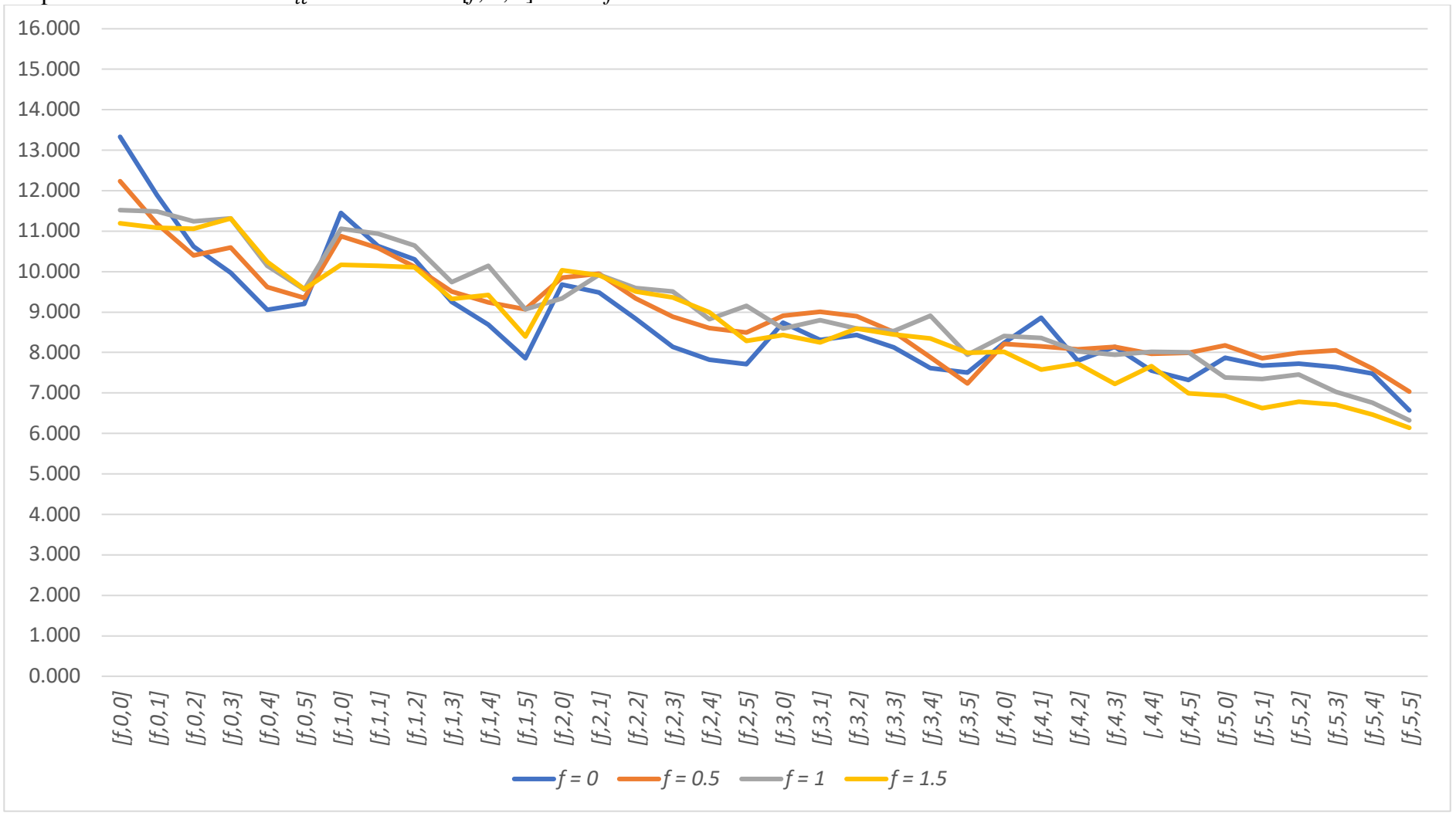
| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.733* | 3.566 | 3.532 | 3.217 | 4.170 | 2.625 |
| 1 | 4.121 | 4.216 | 4.313 | 3.714 | 3.015 | 2.896 |
| 2 | 3.329 | 3.659 | 3.555 | 3.072 | 2.743 | 2.899 |
| 3 | 3.234 | 3.385 | 3.219 | 3.172 | 3.476 | 2.696 |
| 4 | 2.601 | 2.556 | 2.476 | 2.243 | 2.465 | 1.276 |
| 5 | 1.657 | 1.744 | 1.943 | 1.465 | 1.242 | 0.676 |

***f = 1.5***

| *d* \ *h* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.693* | 3.325 | 3.293 | 3.222 | 3.283 | 2.133 |
| 1 | 3.589 | 3.580 | 3.814 | 3.044 | 2.934 | 2.872 |
| 2 | 3.762 | 3.528 | 3.167 | 3.177 | 2.910 | 3.191 |
| 3 | 2.536 | 2.713 | 2.676 | 2.421 | 2.434 | 2.601 |
| 4 | 2.156 | 1.839 | 1.658 | 1.840 | 2.021 | 1.680 |
| 5 | 1.289 | 1.459 | 1.369 | 1.255 | 1.042 | 1.119 |

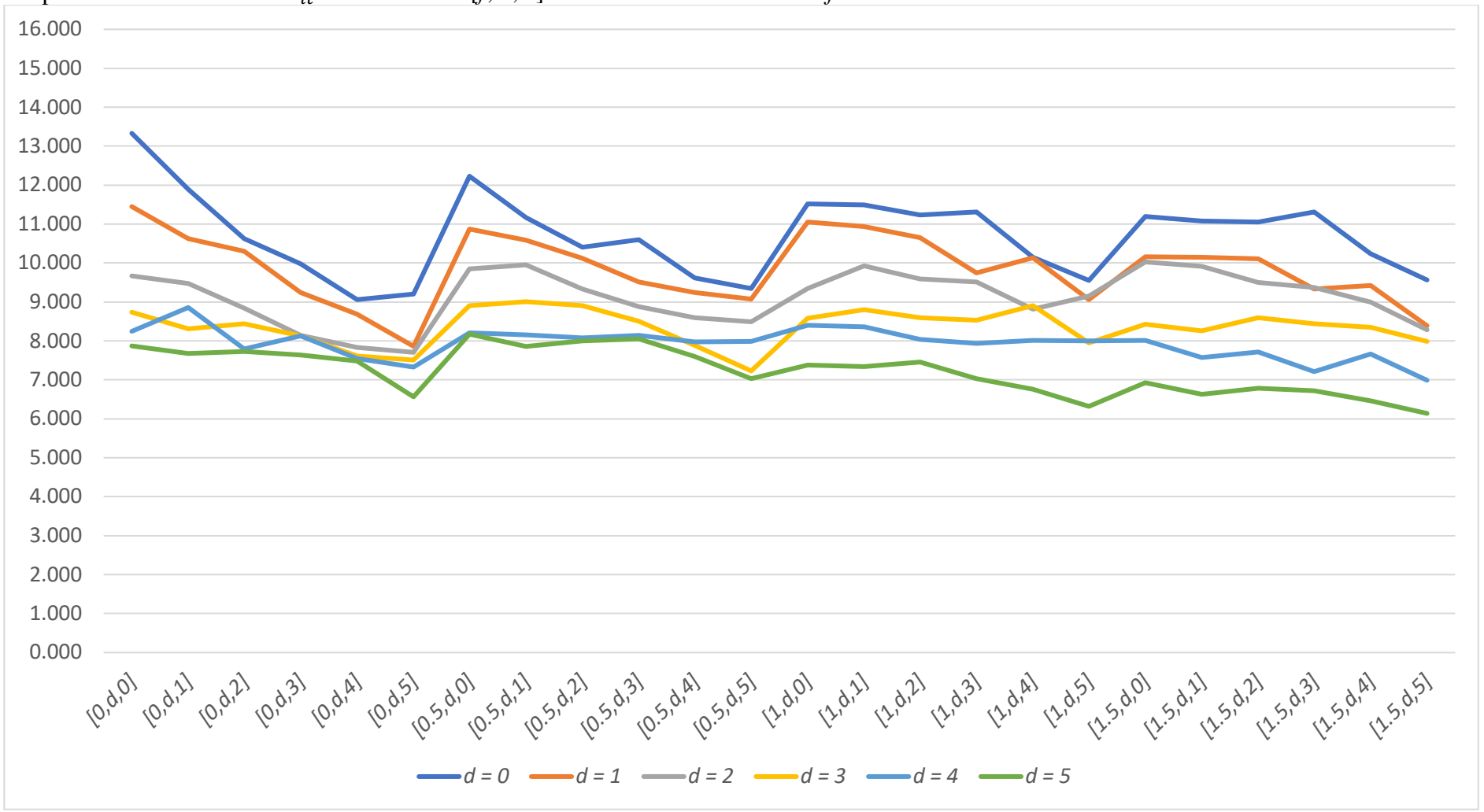
**Appendix 261: EW Software [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



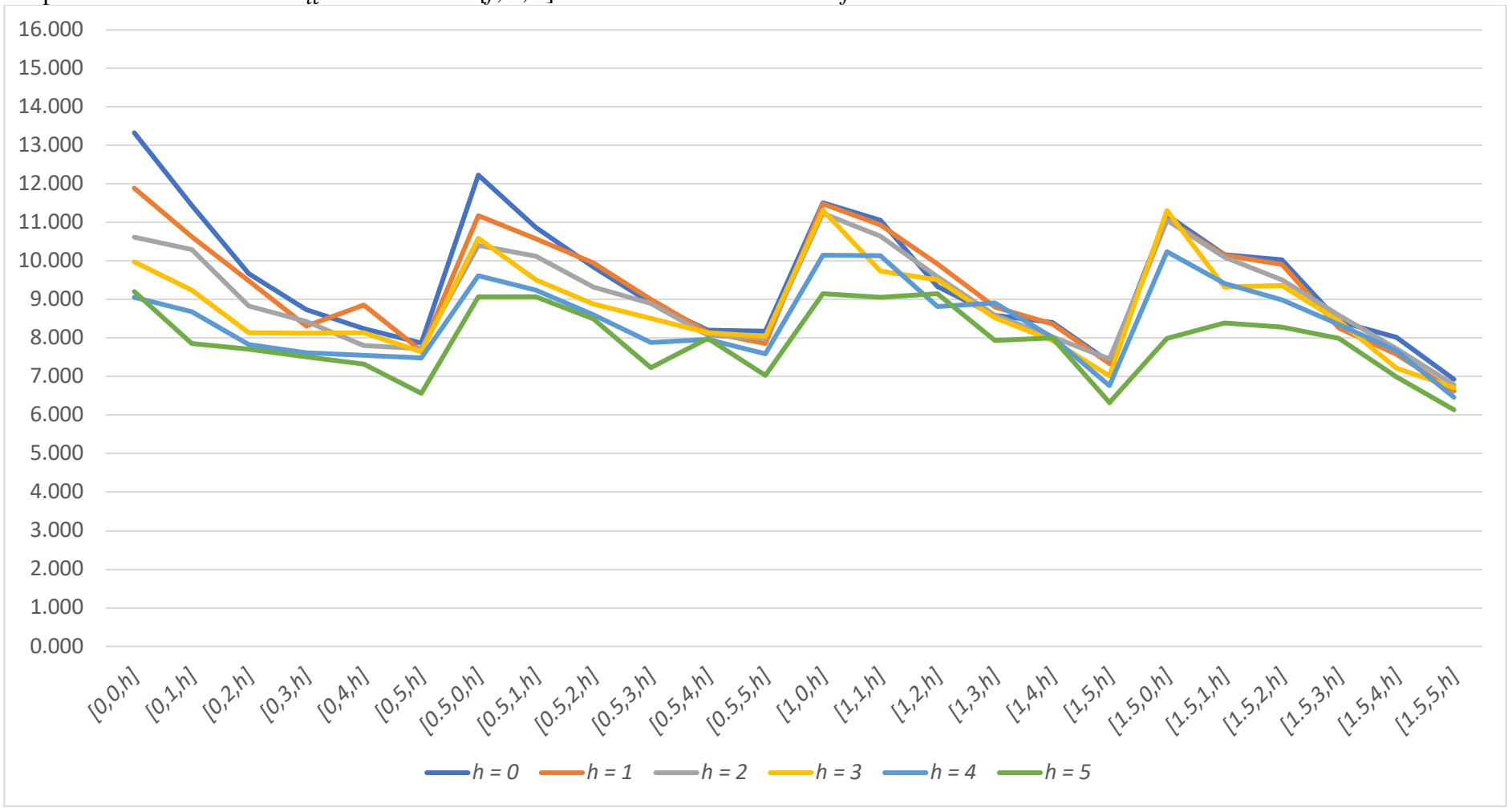
**Appendix 262: EW Software [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 263: EW Software [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 264: EW Software [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.331*** | 11.892*** | 10.623*** | 9.976*** | 9.061*** | 9.208*** |
| 1 | 11.450*** | 10.628*** | 10.297*** | 9.248*** | 8.686*** | 7.863*** |
| 2 | 9.674*** | 9.482*** | 8.837*** | 8.146*** | 7.828*** | 7.708*** |
| 3 | 8.738*** | 8.307*** | 8.438*** | 8.133*** | 7.616*** | 7.509*** |
| 4 | 8.242*** | 8.859*** | 7.800*** | 8.136*** | 7.548*** | 7.324*** |
| 5 | 7.868*** | 7.675*** | 7.730*** | 7.644*** | 7.480*** | 6.571** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 12.234*** | 11.176*** | 10.404*** | 10.596*** | 9.616*** | 9.346*** |
| 1 | 10.875*** | 10.583*** | 10.124*** | 9.513*** | 9.241*** | 9.071*** |
| 2 | 9.847*** | 9.951*** | 9.331*** | 8.885*** | 8.602*** | 8.494*** |
| 3 | 8.909*** | 9.008*** | 8.901*** | 8.507*** | 7.884*** | 7.231*** |
| 4 | 8.211*** | 8.156*** | 8.076*** | 8.140*** | 7.971*** | 7.990*** |
| 5 | 8.174*** | 7.857*** | 7.996*** | 8.051*** | 7.599*** | 7.034*** |

***f = 1***

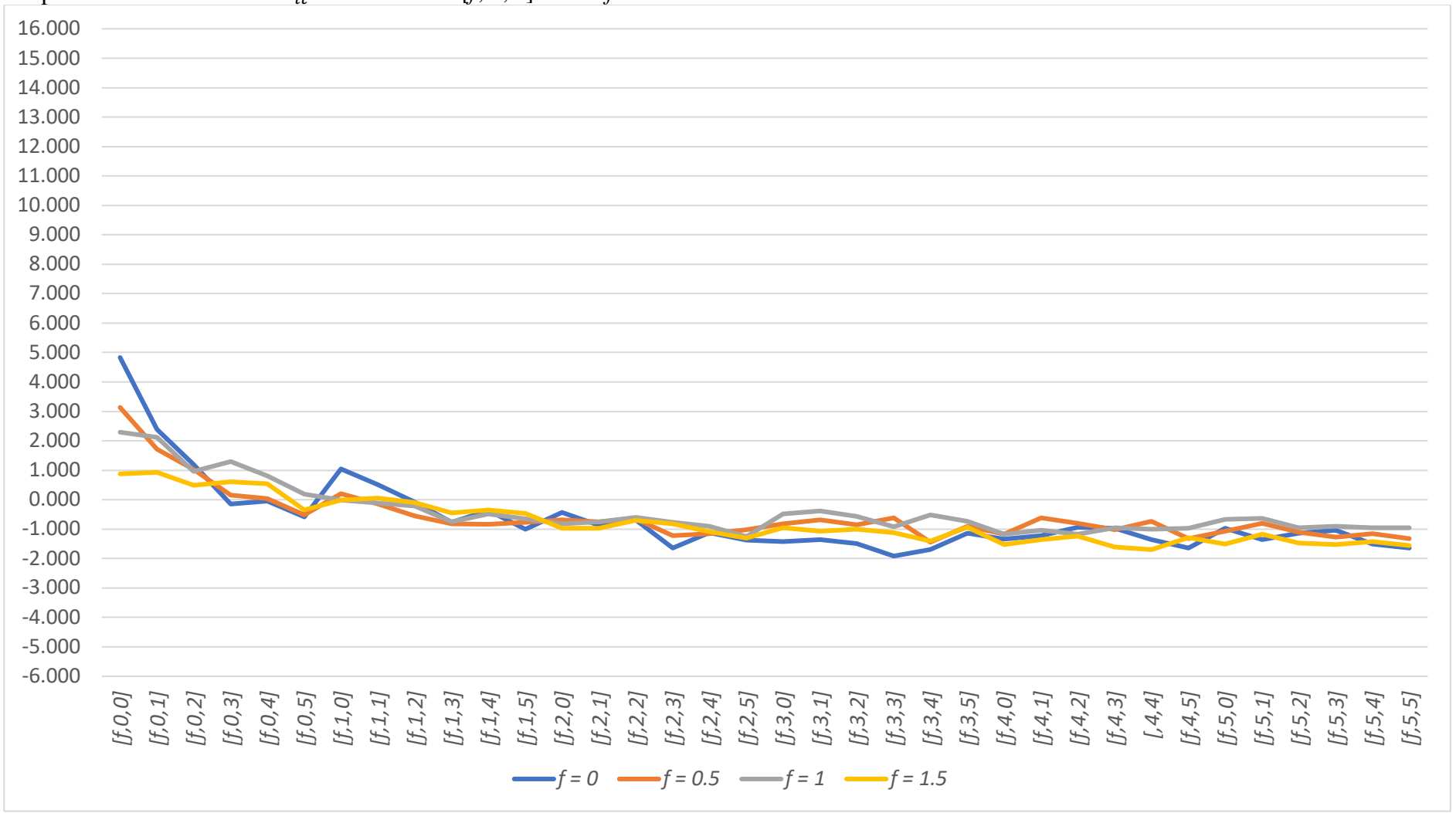
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.519*** | 11.450*** | 10.628*** | 10.297*** | 9.248*** | 8.686*** |
| 1 | 11.054*** | 10.938*** | 10.649*** | 9.743*** | 10.139*** | 9.063*** |
| 2 | 9.341*** | 9.929*** | 9.591*** | 9.511*** | 8.819*** | 9.153*** |
| 3 | 8.588*** | 8.802*** | 8.592*** | 8.529*** | 8.907*** | 7.945*** |
| 4 | 8.406*** | 8.361*** | 8.035*** | 7.942*** | 8.017*** | 8.004*** |
| 5 | 7.385*** | 7.344*** | 7.458*** | 7.026*** | 6.766** | 6.324** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.192*** | 10.875*** | 10.583*** | 10.124*** | 9.513*** | 9.241*** |
| 1 | 10.164*** | 10.149*** | 10.103*** | 9.330*** | 9.418*** | 8.392*** |
| 2 | 10.029*** | 9.910*** | 9.507*** | 9.367*** | 8.998*** | 8.284*** |
| 3 | 8.431*** | 8.255*** | 8.591*** | 8.441*** | 8.349*** | 7.995*** |
| 4 | 8.020*** | 7.577*** | 7.721*** | 7.219*** | 7.668*** | 6.991*** |
| 5 | 6.932*** | 6.626** | 6.787** | 6.717** | 6.465** | 6.140** |

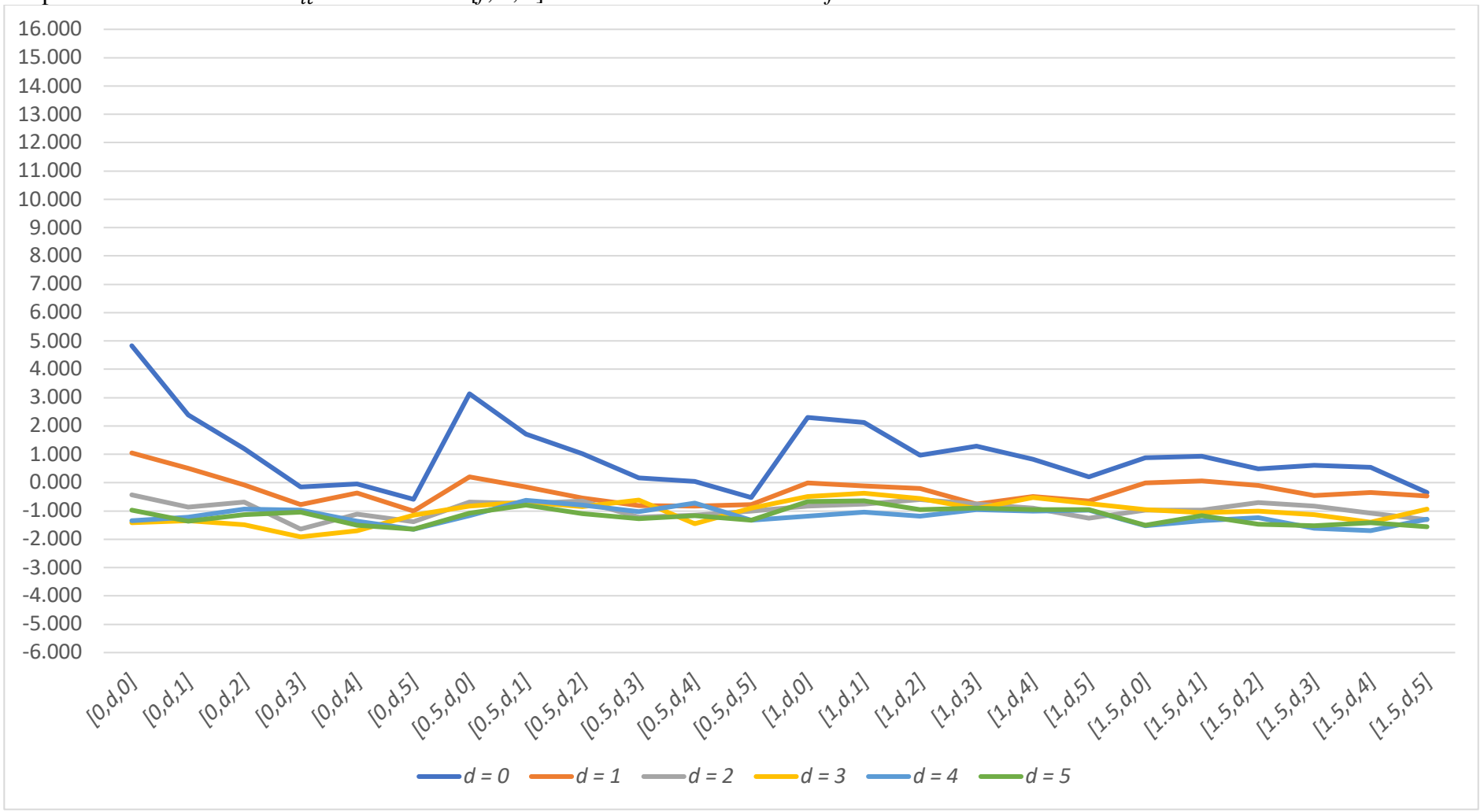
**Appendix 265: VW Chips [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



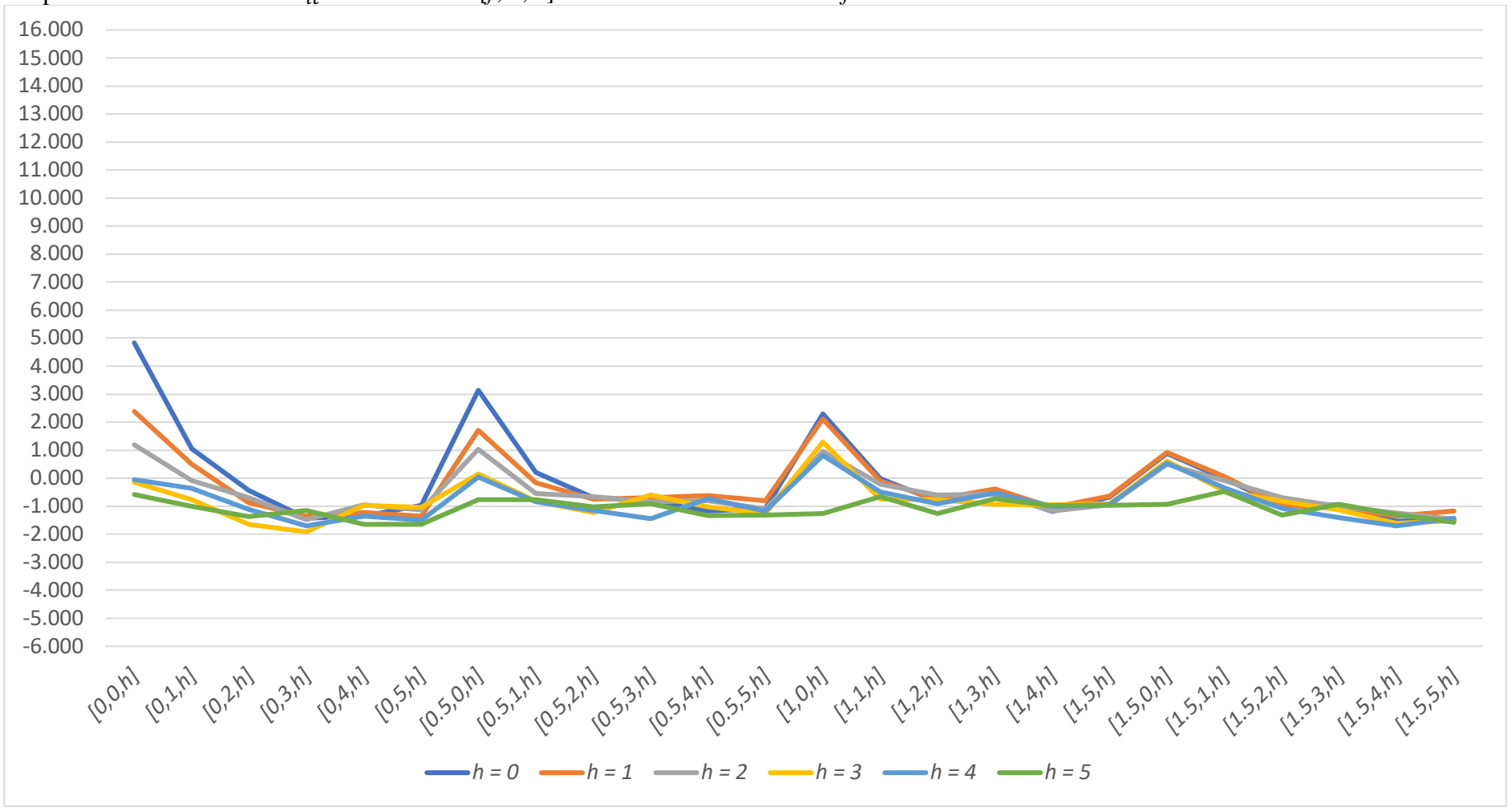
**Appendix 266: VW Chips [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 267: VW Chips [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 268: VW Chips [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 4.831*** | 2.383 | 1.192 | -0.151 | -0.045 | -0.589 |
| 1 | 1.047 | 0.499 | -0.087 | -0.773 | -0.368 | -1.005 |
| 2 | -0.433 | -0.869 | -0.684 | -1.641 | -1.116 | -1.376 |
| 3 | -1.419 | -1.350 | -1.483 | -1.916 | -1.700 | -1.143 |
| 4 | -1.348 | -1.220 | -0.943 | -0.964 | -1.360 | -1.639 |
| 5 | -0.968 | -1.356 | -1.132 | -1.042 | -1.506 | -1.645 |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 3.134* | 1.709 | 1.024 | 0.159 | 0.038 | -0.522 |
| 1 | 0.206 | -0.152 | -0.546 | -0.813 | -0.837 | -0.772 |
| 2 | -0.686 | -0.748 | -0.651 | -1.226 | -1.149 | -1.014 |
| 3 | -0.823 | -0.692 | -0.847 | -0.610 | -1.444 | -0.909 |
| 4 | -1.170 | -0.625 | -0.799 | -1.018 | -0.730 | -1.327 |
| 5 | -1.075 | -0.795 | -1.104 | -1.268 | -1.163 | -1.324 |

***f = 1***

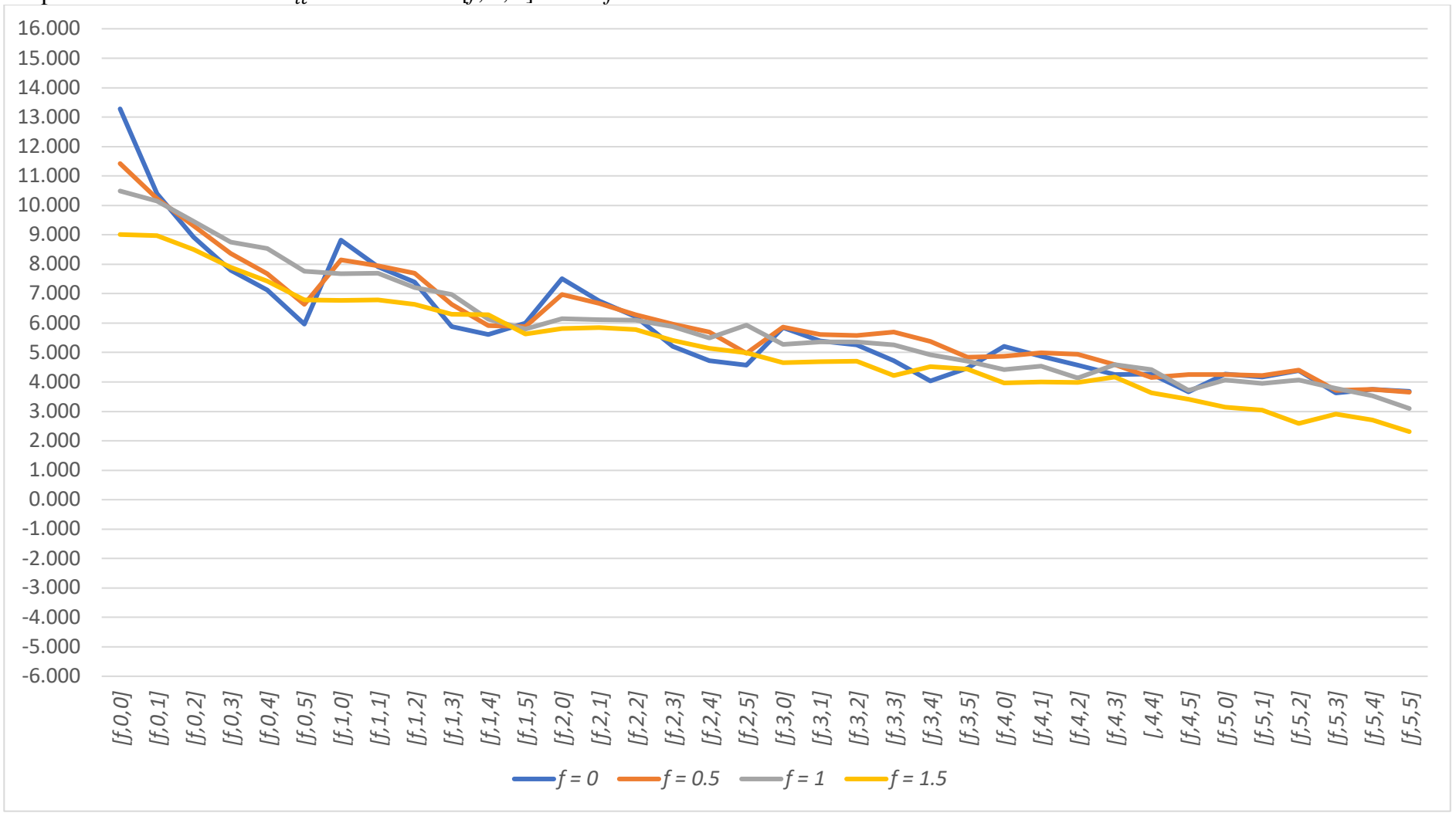
| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 2.292 | 1.047 | 0.499 | -0.087 | -0.773 | -0.368 |
| 1 | -0.006 | -0.114 | -0.215 | -0.755 | -0.488 | -0.659 |
| 2 | -0.823 | -0.753 | -0.607 | -0.761 | -0.904 | -1.255 |
| 3 | -0.491 | -0.376 | -0.564 | -0.925 | -0.525 | -0.737 |
| 4 | -1.180 | -1.046 | -1.177 | -0.953 | -1.007 | -0.978 |
| 5 | -0.676 | -0.643 | -0.950 | -0.904 | -0.946 | -0.960 |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0.885 | 0.206 | -0.152 | -0.546 | -0.813 | -0.837 |
| 1 | -0.006 | 0.052 | -0.096 | -0.458 | -0.344 | -0.470 |
| 2 | -0.978 | -0.974 | -0.699 | -0.823 | -1.081 | -1.309 |
| 3 | -0.956 | -1.065 | -1.012 | -1.126 | -1.407 | -0.933 |
| 4 | -1.530 | -1.352 | -1.243 | -1.612 | -1.697 | -1.291 |
| 5 | -1.505 | -1.164 | -1.471 | -1.519 | -1.420 | -1.566 |

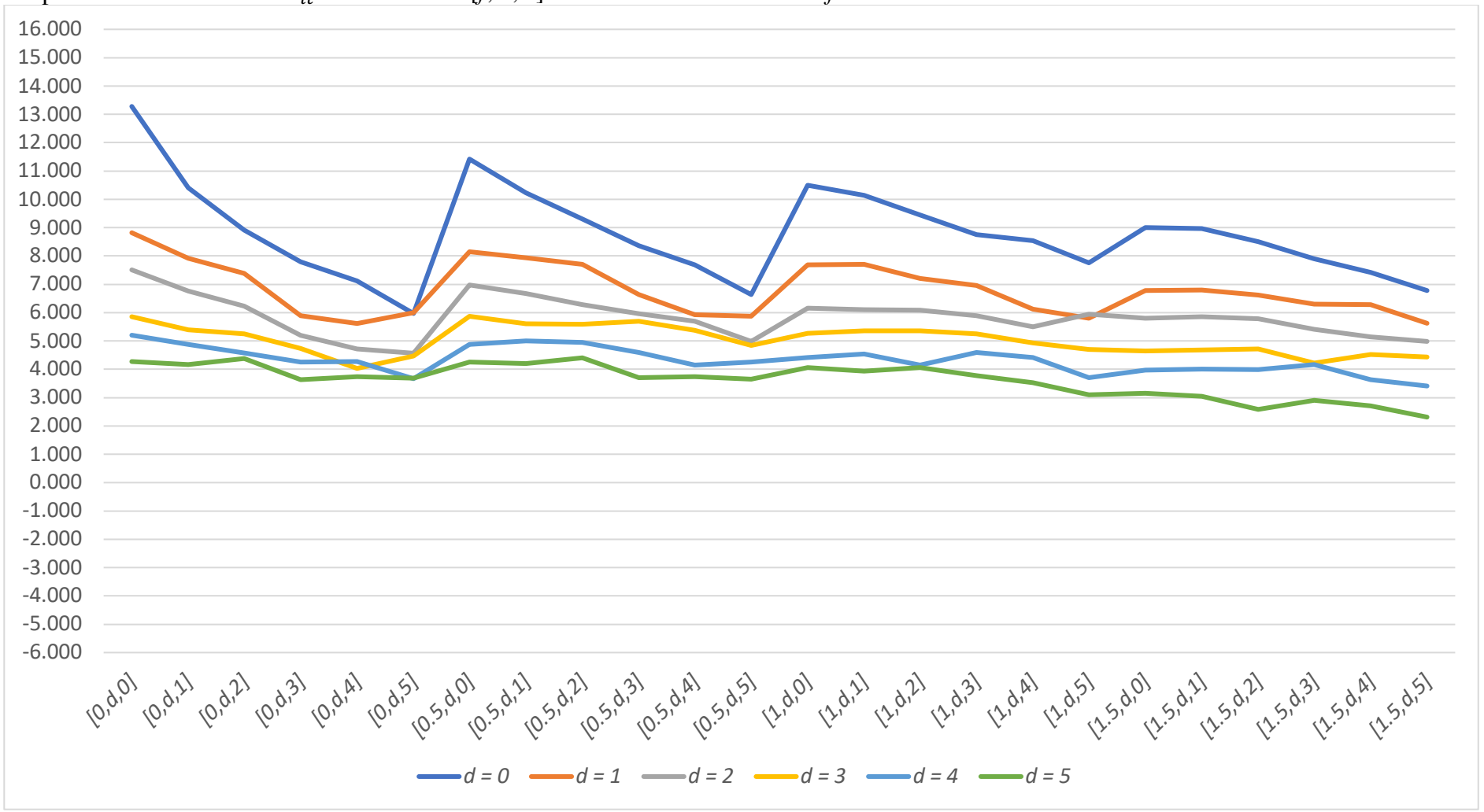
**Appendix 269: EW Chips [*f*, *d*, *h*] Results – *f* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is held constant as $d$ and $h$ increase in value.



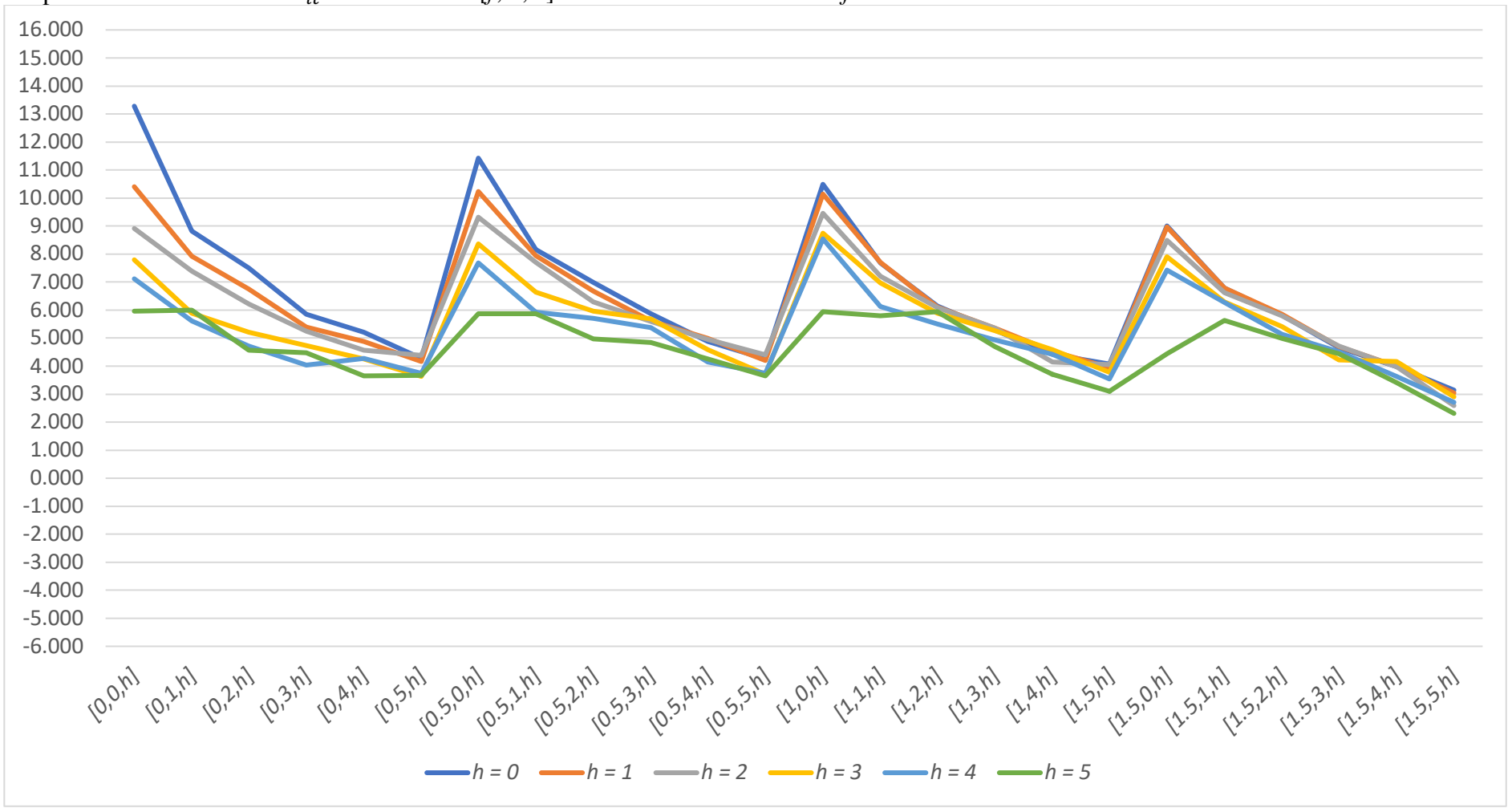
**Appendix 270: EW Chips [*f*, *d*, *h*] Results – *d* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $d$ is held constant as $f$ and $h$ increase in value.



**Appendix 271: EW Chips [*f*, *d*, *h*] Results – *h* Constant**

Graphical Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $h$ is held constant as $f$ and $d$ increase in value.



**Appendix 272: EW Chips [*f*, *d*, *h*] Results**

Results for the $TIS_{it}$ excess returns $[f, d, h]$ where $f$ is the fixed percentage values $0, 0.5, 1, 1.5$, $d$ is the fixed number of days crossed with values 0 to 5 and $h$ is the minimum number of days held with values 0 to 5.

***f = 0***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 13.279*** | 10.404*** | 8.921*** | 7.791*** | 7.125*** | 5.969*** |
| 1 | 8.820*** | 7.919*** | 7.386*** | 5.887*** | 5.616*** | 5.999*** |
| 2 | 7.509*** | 6.756*** | 6.221*** | 5.204*** | 4.723*** | 4.567*** |
| 3 | 5.848*** | 5.392*** | 5.254*** | 4.730*** | 4.031*** | 4.470*** |
| 4 | 5.203*** | 4.877*** | 4.573*** | 4.250*** | 4.273*** | 3.660*** |
| 5 | 4.272*** | 4.161*** | 4.384*** | 3.626** | 3.744*** | 3.678*** |

***f = 0.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 11.421*** | 10.229*** | 9.311*** | 8.371*** | 7.683*** | 6.630*** |
| 1 | 8.156*** | 7.943*** | 7.702*** | 6.640*** | 5.921*** | 5.875*** |
| 2 | 6.981*** | 6.673*** | 6.283*** | 5.965*** | 5.699*** | 4.976*** |
| 3 | 5.871*** | 5.606*** | 5.587*** | 5.690*** | 5.375*** | 4.841*** |
| 4 | 4.874*** | 4.994*** | 4.948*** | 4.593*** | 4.153*** | 4.253*** |
| 5 | 4.256*** | 4.211*** | 4.405*** | 3.711** | 3.741*** | 3.653** |

***f = 1***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 10.488*** | 8.820*** | 7.919*** | 7.386*** | 5.887*** | 5.616*** |
| 1 | 7.684*** | 7.702*** | 7.215*** | 6.966*** | 6.126*** | 5.803*** |
| 2 | 6.154*** | 6.112*** | 6.091*** | 5.885*** | 5.501*** | 5.939*** |
| 3 | 5.276*** | 5.358*** | 5.359*** | 5.259*** | 4.927*** | 4.700*** |
| 4 | 4.422*** | 4.540*** | 4.140*** | 4.592*** | 4.418*** | 3.710*** |
| 5 | 4.066*** | 3.943*** | 4.062*** | 3.780*** | 3.535** | 3.099** |

***f = 1.5***

| d \ h | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 9.010*** | 8.156*** | 7.943*** | 7.702*** | 6.640*** | 5.921*** |
| 1 | 6.779*** | 6.796*** | 6.629*** | 6.297*** | 6.281*** | 5.633*** |
| 2 | 5.807*** | 5.853*** | 5.788*** | 5.405*** | 5.140*** | 4.990*** |
| 3 | 4.653*** | 4.688*** | 4.713*** | 4.213*** | 4.514*** | 4.432*** |
| 4 | 3.975*** | 4.002*** | 3.982*** | 4.170*** | 3.626** | 3.410** |
| 5 | 3.145** | 3.043** | 2.591* | 2.906** | 2.710* | 2.312 |